BULLETIN OF THE SCHOOL OF EDUCATION INDIANA UNIVERSITY

Vol. XVIII November, 1942 No. 6

Bureau of Cooperative Research and Field Service
School of Education
Indiana University, Bloomington, Indiana

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Price, 50 cents, postpaid
For sale by the Indiana University Bookstore,
Bloomington, Indiana

This bulletin is indexed by title in the following:
Bibliographic Index
The current literature section of the
Loyola Educational Digest
Wilson Education Index

Entered as second-class mail matter September 26, 1921, at the post office at Bloomington, Indiana, under the Act of August 24, 1912. Published in January, March, May, July, September, and November of each year, from the University Office, Bloomington, Indiana.

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BULLETIN OF THE SCHOOL OF EDUCATION
INDIANA UNIVERSITY

An Analysis of Arithmetic Textbooks (Second Period—1821 to 1850, and Third Period—1851 to 1880)

by
HENRY LESTER SMITH
and
MERRILL THOMAS EATON

A List of Bulletins in the Field of Education, Indiana University

by
KATHLEEN DUGDALE

Published by the
BUREAU OF COOPERATIVE RESEARCH
AND FIELD SERVICE
Indiana University

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An Analysis of Arithmetic Textbooks (Second Period—1821 to 1850 and Third Period—1851 to 1880)

H. L. Smith and M. T. Eaton

INTRODUCTION

This bulletin contains the second and third parts of a quantitative-qualitative analysis of the content of representative arithmetic textbooks published from 1706 to 1940 inclusive. This period of more than 200 years was divided into five smaller periods, as follows:

1. Up to and including 1820
2. From 1821 to 1850, inclusive
3. From 1851 to 1880, inclusive
4. From 1881 to 1910, inclusive
5. From 1911 to 1940, inclusive

The analysis of textbooks published during the years included in the first of these five periods has been published as Volume XVIII, Number 1, of the *Bulletin of the School of Education*, Indiana University, in January, 1942. The second and third parts of the analysis, the present bulletin, attempt to present a picture of the nature, trends, and adaptations of arithmetic texts in the next two periods, from 1821 to 1850 and from 1851 to 1880. Since the books did not always give a copyright date, the date given in the preface or in letters from educators who had examined the text are used as the publication date. While only seven books were analyzed in the first period, as many as 12 are included in the study of the second period and 16 in the study of the third period. Interesting differences in these arithmetics indicate the trends of the times and the changes taking place in teaching methods and materials.

SECOND PERIOD—1821 to 1850

GENERAL DESCRIPTION OF THE TEXTBOOKS USED

A list of all the books analyzed in the second period of the study follows:

*9. Colburn, Warren. *Colburn's First Lessons. Intellectual Arithmetic, upon the Inductive Method of Instruction.* Oliver L. Sanborn, Concord, N.H., 1821.

10. Thompson, Zadock. *The Youth's Assistant in Practical Arithmetic. Designed for the Use of Schools in the United States* (eighth edition). David Watson, Woodstock, Vt., 1825.

11. Hassler, F. R. *Elements of Arithmetic, Theoretical and Practical; Adapted to the Use of Schools, and to Private Study.* G. C. and H. Carvill, New York, 1826.

12. Smiley, Thomas T. *The New Federal Calculator, or Scholar's Assistant: Containing the Most Concise and Accurate Rules for Performing the Operations in Common Arithmetic; together with Numerous Examples Under Each of the Rules, Varied so as to make them Conformable to Almost Every Kind of Business; for the Use of Schools and Counting Houses.* Lippincott, Grambo, and Co., Philadelphia, 1828.

13. Ostrander, Tobias. *The Elements of Numbers, or Easy Instructor; Being a New and Comprehensive System of Practical Arithmetic. Calculated for the Use of Schools Throughout the United States.* Morse and Harvey, Canandaigua, N.Y., 1929.

14. Guthrie, Jesse. *The American Schoolmaster's Assistant; Being a Compendious System of Vulgar and Decimal Arithmetic: Containing the Usual Methods of Calculation, with the Calculation of Federal Money Dispersed throughout the Whole, and Adapted to the use of Schools in the United States* (sixth edition, revised and corrected). L. Collins and B. Cox, Maysville, Ky., 1834.

15. DeMorgan, Augustus. *The Elements of Arithmetic.* John Taylor, London, 1835.

16. Talbott, John L. *The Western Practical Arithmetic, Wherein the Rules are Illustrated, and Their Principles Explained: Containing a Great Variety of Exercises, Particularly Adapted to the Currency of the United States: to which is added A Short System of Book-keeping, Designed for the Use of Schools and Private Students* (revised and improved). E. Morgan and Co., Cincinnati, 1841.

17. Adams, Daniel. *Adam's New Arithmetic—Revised Edition. Arithmetic, in which the Principles of Operating by Numbers are Analytically Explained and Synthetically Applied. Illustrated by Copious Examples. Designed for the Use of Schools and Academies.* Collins and Brother, New York, 1848.

18. Chase, Pliney E. *The Common-School Arithmetic, Designed for Learners of Every Class; and Particularly for Those who are*

* The first eight books are those included in the first period (Bulletin of the School of Education, January, 1942).

Desirous of Acquiring a Thorough Knowledge of Practical Mathematics. A. Hutchinson and Co., Worcester, Mass., 1848.

19. Perkins, George R. *An Elementary Arithmetic, Designed for Academies and Schools: Also Serving as An Introduction to the Higher Arithmetic* (revised and improved edition). D. Appleton and Co., New York, 1849.
20. Davies, Charles. *Arithmetic, Designed for Academies and Schools; Uniting the Reasoning of the French with the Practical Methods of the English System. With full illustrations of the Method of Cancellation* (improved edition). A. S. Barnes and Co., New York, 1849.
    First Lessons in Arithmetic, Combining the Oral Method with Slate Exercises. A. S. Barnes and Co., New York, 1852.*

A brief description of each of the texts analyzed is presented here in order to acquaint the reader with the general format of the books studied and to point out the author's purposes and approaches, the methods used in presenting the materials, and the general nature of the content of each text.

Colburn's *Intellectual Arithmetic*, the earliest of the 12 books included in this period, was well known because of its radical departure from the traditional method of presenting the subject. The only copy of the text available for this study was printed in 1837, but since it is evidently an unrevised printing of the text originally published in 1821, the earlier date has been considered the publication date of this book for purposes of this analysis. As mentioned in the subtitle, the author developed his book "upon the inductive method of instruction." This was an innovation in the presentation of arithmetic concepts and has been recognized for a long time as a most significant one. A letter to the author from Henry Colman, printed in the text, points out that Colburn was greatly influenced by the system and philosophy of Pestalozzi. Heretofore the deductive method of presenting arithmetic had predominated, and the organization of the content had been logical rather than psychological or natural.

According to the author's preface to the book, the theory of learning adhered to in the preparation of the text is that the child at a very early age gains a few basic mathematical ideas, such as concepts of unity and of more and less, and that as soon as these concepts have been acquired the child is ready to solve simple concrete problems utilizing them. Gradually, then, the child learns more expeditious ways of making his calculations and proceeds to the solving of more complex and abstract problems. In discussing this, Colburn says:

It is necessary rather to furnish occasions for them [the children] to exercise their own skill in performing examples, than to give them rules. They should be allowed to pursue their own method first, and then they should be made to observe and explain it; and, if it was

* These two arithmetics are included here as one book since the second (published in 1852) is intended to serve as an introductory work to the advanced work published in 1849.

not the best, some improvement should be suggested. By following this mode, and making the examples gradually increase in difficulty; experience proves that, at an early age, children may be taught a great variety of the most useful combinations of numbers.

To provide these occasions, the book consists almost wholly of problems. Besides, the author believes that arithmetical calculations serve better than almost any other type of exercise to "strengthen and mature the mind," providing the examples are sufficiently simple to be understood by the pupil. Such mental discipline is deemed to be a product of the exercise of the process of reasoning, with the attendant certainty of the results.

Colburn further points out that the child first acquires his sense of number by observing objects, and then, through application and generalization, develops general principles. He says:

Having observed that this quality is common to all things with which we are acquainted, we obtain an abstract idea of number. We first make calculations about sensible objects; and we soon observe, that the same calculations will apply to things very similar; and, finally, that they may be made without reference to any particular things. Hence from particulars we establish general principles which serve as a basis for our reasonings, and enable us to proceed, step by step, from the most simple to the most complex operations. It appears, therefore, that mathematical reasoning proceeds as much upon the principle of analytic induction, as that of any other science.

As cited in the preface, Colburn's own criticisms of the common methods of introducing arithmetic which were prevalent at that time also show some factors which he tried to avoid in the preparation of his text. He complains that in common practice:

The examples are so large that the pupil can form no conception of the numbers themselves, therefore, it is impossible for him to comprehend the reasoning upon them. Secondly, the first examples are usually abstract numbers. This increases the difficulty very much, for even if the numbers were so small, that the pupil could comprehend them, he would discover very little connection between them and practical examples. . . . Thirdly, the numbers are expressed in figures, which, if they were used only as a contracted way of writing numbers, would be much more difficult to be understood at first than the numbers written at length in words. But they are not used merely as words; they require operations peculiar to themselves. They are, in fact, a new language, which the pupil has to learn.

The common method . . . entirely reverses the natural process; for the pupil is expected to learn general principles, before he has obtained the particular ideas of which they are composed.

By way of carrying out his theory of presenting arithmetic by the natural process of analytic induction, each new phase of content in Colburn's text begins with simple, practical problems in concrete terms, using words instead of Arabic symbols. These are then followed by closely related abstract problems, after which are more practical questions. Abstract examples are not given and rules are not stated as such. The pupil is expected to derive his own statements of principles and rules from his experiences in solving at first the simple and later the more complex problems set for him. The order of topics in the book is addition and subtraction, multiplication, di-

vision, multiplication and division combined, finding the fractional parts of a number, finding what part one number is of another, miscellaneous examples, and fractions of unity. At the end of the book is a long section called a Key in which several examples from each section are solved and explained.

The copy of Colburn's text available for this study has a light brown board back with brown leather binding. It has 172 numbered pages, each full page containing approximately 2¾ by 4⅞ inches of printed space. The paper evidently was of poor quality for it is entirely brown with age. The type is very small and closely spaced. The size and spacing of the type and the mottled brown of the pages make the book relatively difficult to read. Each full page contains the approximate equivalent of 315 six-letter words.

Thompson introduces his textbook, *The Youth's Assistant*, with three pages of mental arithmetic, consisting of 38 simple problems (concrete and abstract) on addition, 22 on subtraction, 24 on multiplication, 18 on division, and 9 on fractions. Since the book was not published until 1825, it seems quite possible that the inclusion of this brief section on mental arithmetic may have been influenced by Colburn's earlier work. The examples are very similar to those which Colburn used to introduce the various processes in his text. They are easy concrete problems stated without the use of Arabic symbols.

Though Thompson implies in his preface that this brief system of mental arithmetic is a result of his own originality, he indicates considerable lack of conviction on his part relative to its importance in a system of common arithmetic. He says:

> That habits of mental computation have a salutary influence upon the mind, by rendering the memory retentive, and producing a promptness of recollection, cannot for a moment be questioned. But to what extent this habit may be profitably cultivated, or what place it should occupy in our systems of common arithmetic, experience has not yet fully determined. The examples here given are principally designed for very young scholars, and such as are supposed to have paid no attention to arithmetic; but they will also afford a profitable exercise for such as are somewhat advanced. The number of questions here given are necessarily limited; but the instructor can extend it at pleasure by selections from the succeeding part of the work or by original examples.

He makes no claims to originality in preparing the remainder of the text. He states that he has merely tried to combine the best features of the books then in common use "in a lucid and perspicuous manner, and to exclude all that is foreign to the subject, or unimportant to the student."

The main body of the book clearly follows the deductive procedure. The general order of presentation for each division of content is definition, a detailed statement of a rule, an example in abstract numbers with a written explanation of the process, abstract drill problems, problems applying the principle to concrete practical situations, and a list of questions pertaining to the definition and process. There are also extensive footnotes, often occupying nearly half a page, containing additional examples and explanations. The

author says that "a sufficiency of demonstration is introduced in the notes to afford the scholar a correct idea of the reasoning upon which the several rules are founded."

Furthermore, the author states that he has endeavored to arrange the rules in order of sequence according "to their similitude or dependence." This order is: fundamental processes applied to simple numbers and then applied to compound numbers; vulgar fractions; decimal fractions; federal money; proportion; taxes; interest, including discount, commission, brokerage, and insurance; practice; tare and trett; equation of payments; fellowship; barter; loss and gain; alligation; powers and roots; progression; annuities; position; permutation; mensuration of surfaces and solids; philosophical matters of falling bodies, pendulums, etc.; miscellaneous questions; and business forms.

The copy of Thompson's text which was used for this analysis has a light brown board back with a brown leather binding. The book has 160 numbered pages, each full page containing approximately 4 by 6⅝ inches of printed material. The type is relatively small throughout the body of the work and the footnotes are set in very small type. The introductory phrases of rules are usually set in italics. Most lists of concrete problems are presented on the page in two parallel columns. The paper seems to be of poor quality; it is brown with age and the edges of many of the pages are considerably frayed. Each full page contains the approximate equivalent of 598 six-letter words.

Hassler, in the introduction to *Elements of Arithmetic*, states that reasoning is a major objective of the study of arithmetic:

> Arithmetic contains the first elements of reasoning upon *quantity*; its principles take their rise in ideas so simple as to be adapted to the most untutored mind, and to the lowest capacity.
>
> By its very nature it furnishes the means of developing the reasoning faculties, from the time of their first beginning to expand, and of habituating them to correctness and precision. It therefore gives the human mind the power and disposition to reason upon *sound* and *correct principles*.

He also points out that a knowledge of mathematical processes is indispensable to every individual in daily life and to those engaged in scientific study.

He criticizes the teacher who emphasizes the mere memorization of rules and states that "the cultivation of the memory alone is, from the very constitution of the human mind, always detrimental to the reasoning faculty." Furthermore, he emphasizes the point that understanding is the essential goal to be sought rather than the learning of the mechanical process used in performing the task. To carry out this purpose the author has introduced each process with a lengthy treatise in which he attempts to explain and prove "the propriety and correctness of any step that is taken, by previous reasonings, leading to the discovery of the principle that ought to direct it, and therefore pointing out the rule for the appropriate operations. . . ."

In the introduction, the point of view is expressed that "the young and untutored mind, in truth, reasons analytically; a boy, and in fact a man, always asks *Why?*" It is pointed out that synthetical reasoning cannot be performed until after the individual has gained previous information. The author attempts, in his explanation of each section or process, so to simplify the presentation that the youth or man will be able to follow through by analytical reasoning—that he might learn to understand the processes even without the aid of a tutor.

The greater part of the text is given to this analytical reasoning and explanation of examples. These explanations are followed by a few drill problems and a brief list of concrete problems, or practical problems of application. The explanations, by steps in reasoning, gradually lead to statements of rules. It is stated that special effort has been made to organize the content systematically, so that each new process may be felt to grow out of the preceding ones naturally. In most cases, the relation between processes is carefully pointed out.

On the whole, the discussions and explanations are written in such complex statements and in such abstract terms that it would be necessary for a child to develop considerable ability in reading for comprehension before he would be able to understand them.

The copy of Hassler's book used in this study is bound in a brown leather-covered board back. The paper on which it is printed has a rough surface and most of the pages are beginning to show brown spots. The book contains 219 numbered pages, each full page containing approximately 3 by 5⅝ inches of printed material. The type is very small and rules are set in italics. Each full page contains the approximate equivalent of 414 six-letter words.

Smiley points out in the preface to his text, *The New Federal Calculator*, that he attempted to prepare a book better adapted to the current art of imparting instruction to youth. He states that one of the chief features of the book is the great amount of space given to federal money, which is treated under compound denominate numbers. A second objective, which suggests the method of teaching and learning then in vogue, was to present rules so that they might be easily memorized. The author recommended that each rule be thoroughly learned, preparatory to the working of the problems which follow it.

The general order of the treatment of each division of the content is as follows: definitions, rules, questions on definitions and rules, examples, drill problems, and practical exercises (written problems). Smiley's approach is entirely counter to that of Colburn and wholly different from that of Hassler. Reasoning and understanding receive little emphasis, while the steps of each mechanical process are outlined in detail and the questions merely call for drill in memorizing concise definitions and statements regarding the mechanical steps involved. The following unit on subtraction is typical:

Subtraction

Subtraction is used to ascertain the difference between two given numbers.

The larger number is called the minuend, the less the subtrahend, and their difference the remainder.

Rule

1. Set down the larger number first, and under it, (with units under units, tens under tens, etc.) the less number.
2. Then begin at the right hand or units' place, and take the lower figure from that which stands immediately above, if the upper figure be more than the lower, and set down the remainder.
3. But if the upper figure be less than the lower, add ten to the upper figure, take the lower figure from the amount, set down the remainder and carry one to the next lower figure.

Proof.—Add the less number and the remainder together, and the amount will be equal to the greater number.

Questions

For what purpose is subtraction used?
What names are used to distinguish the larger number, smaller number, and the difference between the two numbers?
Repeat the rule for performing the operations in subtraction?
How is subtraction proved?

The above concise mechanical outline is followed by a subtraction table and three solved examples using abstract numbers. The first example identifies the terms as follows:

421352 minuend
210141 subtrahend

211211 remainder

Eight similar problems, but without the answers, are presented in column arrangement and nine horizontally. These abstract drill exercises are followed by seven "practical exercises"—written problems applying subtraction to concrete situations. Hence the procedure is entirely deductive; the pupil is required to memorize the process without any explanation of the reasons why, and to apply it to abstract numbers of such size as to be no doubt meaningless, before he finds any practical use for his learning.

In a sense, Smiley's text is a concise handbook of arithmetic instead of an instrument for clarifying mathematical concepts or for stimulating thinking relative to mathematical relations.

The book used is small and has a brown board back with a black leather binding. It has 180 full pages and each full page contains the approximate equivalent of 361 six-letter words printed in about 2¾ by 4⅝ inches of space surrounded by a frame of black lines. The quality of the paper is not the best and the type is very small.

The copy of Ostrander's *Easy Instructor* used in this study represents a revision and improvement of former editions of the text. The author points out that problems in earlier editions, which had appeared too abstruse and difficult, have been removed and easier problems have been substituted. Likewise, rules which rarely, if ever, occur in business have been supplanted by more pleasant and useful ones. His

aim toward simplicity is perhaps well expressed by these lines found on the title page:

> Make the rough path of Science plain to find,
> And through its mazes lead the pleasur'd mind.

In his preface to the text Ostrander expresses the opinion that most arithmetics of the day were weak in their treatment of United States currency, of decimals, and of mensuration of superficies and solids. In his attempt to eliminate these weaknesses, his chief purpose was to create a more useful elementary school text, so that pupils might be equipped with knowledge needed in life, in case they should not have the opportunity of attending an academy or college.

The author further points out that, since decimals differ from whole numbers only to the extent of the decimal points, he has considered them immediately following whole numbers. Since United States money is decimal, it is included with decimals. Since vulgar fractions are "more difficult and of little use" they are merely reduced to decimals in the fore part of the book, and are then treated more extensively near the end of the text. Rules of proportion follow the compound rules and rules of reduction.

The deductive process of definition, rule, example, abstract drill problems, written problems of application, and drill questions is the order of presentation throughout the text. Similar to the text prepared by Smiley, this work of Ostrander is little more than a handbook of simplified rules for numerous detailed mathematical processes. The rules concisely state each of the mechanical steps to be taken in order to determine the answer. Each of the rules is followed by one or more solved examples. In these examples large abstract numbers are used. Numbers so large as to be almost meaningless to children are also used in some of the problems of application, although many of the numbers are of the size likely to be found in everyday business transactions. The questions at the end of each detailed division of the text are not designed to stimulate reasoning, but instead call for a repetition of facts as stated in definitions and rules.

The copy of Ostrander's book available for this study has a light grey board back with a brown leather binding. It contains 182 numbered pages plus 8 pages on which are presented a simple system of bookkeeping. Each full page contains approximately 2⅞ by 5 inches of printed space and the approximate equivalent of 414 six-letter words. The type is very small and the introductory phrases of rules are set in italics.

Guthrie, in the preface to his *The American Schoolmaster's Assistant*, states that his aim is "to furnish schools with a comprehensive, easy, practical system of arithmetic." He also states that he has endeavored to make the rules "short, easy and exact, and clearly explained," and to arrange them in order of difficulty with particular regard for "the capacity of young learners."

The deductive method of presentation is used throughout. The abstract examples and drill exercises frequently use very large numbers, but the written problems of application seem to present ex-

amples which would be similar to those met in life situations. Though the author states that he has attempted to explain rules clearly, such explanations seem to be largely a detailed outline of the mechanical steps involved in deriving the solution rather than an explanation of reasons why the rule is true. Thus, the *how* for specific types of problems rather than the *why* of mathematical theory is emphasized throughout the text.

Both federal money and sterling money are included, the latter being retained because of our intercourse between Great Britain and her dependencies. Geometrical definitions and mensuration are included in an appendix. Considerable emphasis is given to such practical business transactions as exchange, barter, profit and loss, partnership, insurance and commissions, and annuities.

The copy of Guthrie's book available for our study has a grey board back with a brown leather binding. The paper seems to be of good quality. The type is fairly small throughout. The book contains 200 numbered pages, each full page containing approximately 3⅛ by 5⅝ inches of printed space. Converted to a standard basis, each full page contains the approximate equivalent of 395 six-letter words.

DeMorgan's *The Elements of Arithmetic* represents a very different approach from that found in the other books of the period. Though the copy used in this analysis was published in 1835, it is pointed out that it varies little from the 1832 edition. It appears from the preface that the author's aim was to develop an understanding of the mathematical processes rather than to provide mere drill on the steps necessary to solve particular types of problems. He says:

> All who have been engaged in the education of youth are aware that it is a hard thing to make them think; so hard, indeed, that masters had, within the last few years, almost universally abandoned the attempt, and taught them rules instead of principles; by authority instead of by demonstration. This system is now passing away, and many preceptors may be found who are of opinion that . . . their pupils should always be induced to reflect upon, and know the reason of, what they are doing.
>
> . . . . . .
>
> It is no exaggeration to say, that under the present system, five years of a boy's life are partially spent in merely learning the rules contained in this treatise, and those, for the most part, in so imperfect a way, that he is not fit to encounter any question unless he sees the head of the book under which it falls.

With regard to the methods to be used for developing this thinking on the part of the learners, DeMorgan recommends:

> Let the pupils be taught in classes, the master explaining the article as it stands in the work. Let the former then try the demonstration on some other numbers proposed by the master, which should be as simple as possible. The very words of the book may be used, the figures being changed, and it will rarely be found that a learner is capable of making the proper alterations, without understanding the reasoning. . . . When the principle has been thus discussed, let the rule be distinctly stated by the master or some of the more intelligent of the pupils, and let some very simple example be

worked at length. The pupils may then be dismissed, to try the more complicated exercises with which the work will furnish them, or any others which may be proposed.

Thus the inductive approach is attempted to a certain extent. Even though much of the introductory explanatory material is a little difficult to understand, the few concrete examples given are simple enough. Generally, explanations are quite abstract; principles and processes are often demonstrated and explained by use of algebraic symbols (letters). To teach complete understanding of the principle through abstract and a few concrete examples, an explanation is attempted in each instance before the presentation of the formal rule. These are usually followed by a few drill problems and written problems of application. On the whole, however, the book contains very few problems. It must be remembered that the author suggests in the preface that the teacher provide additional, simple introductory exercises in large classes until the pupils are able to demonstrate their understanding of each principle.

The copy of DeMorgan's book available for this study is bound in leather-covered board. It has 190 numbered pages, each full page containing about 3⅝ by 6 inches of printed space and the approximate equivalent of 330 six-letter words. The type is slightly smaller than the average found in advanced books today. The paper seems to be of very good quality.

Talbott's *The Western Practical Arithmetic* is another book which is essentially a handbook of definitions and rules for detailed processes, plus lists of problems to be solved by the rules. In discussing his work in the preface, the author does not claim to have discovered any improved technique of presentation; instead, he states that he has founded his work "on the belief that *labor* and *labor only*, can insure success in any pursuit; and that labor should always be bestowed upon those objects which produce the greatest useful result."

With regard to presentation of the fundamental processes, the author states:

> In the selection and arrangement of matter . . . those rules that are of the most general use, have been presented first, and their exercises made extensive, that the pupil may become familiar with their principles, and expert in their application.
>
> The explanations accompanying the rules, are designed to facilitate the progress of private students, and to diminish the labor of teachers, especially in large schools, where they are unable to give to each pupil the necessary explanations.

In order to increase the practical value of the work Talbott has included in the text such items as mensuration of carpenter's, mason's, and plasterer's work and a simple system of bookkeeping.

The deductive procedure of definition, rule, example, drill problems, and written problems is followed throughout the book. Very little space is given to explanations, but each rule is stated in such a manner as to indicate concisely the detailed steps in the procedure. The questions for each division merely call for a restatement of definitions and steps in processes.

The copy of Talbott's book available for this study has a grey board back with a brown leather binding. On the outside of both the front and back covers replicas of the title page are printed. The book is small, each full page containing only about 2⅞ by 5¼ inches of printed space, and the approximate equivalent of 366 six-letter words. Each page is framed by rectangular lines. The paper is not glazed and seems to have been of good quality. As a whole, the type is quite small, and that presenting the explanations of examples is very small.

In the preface to *Adams' New Arithmetic*, the author points out that he has attempted to combine the synthetic method and the analytic method as applied by Warren Colburn. The 1848 edition used in this study is a revised form, the first edition having been published as early as 1827. Adams points out that his book has been widely accepted on its own merits and gives the following sidelight on practices sometimes resorted to at that time to publicize a work:

> And, let it be remarked, it has secured this extensive circulation solely by its merits. Teachers, superintendents, and committees have adopted it because they have found it fitted to its purpose, not because hired agents have made unfair representations of its merits, and, of the defects of other works, seconding their arguments by liberal pecuniary offers—a course of dealing recently introduced, as unfair as it is injurious to the cause of education.

The author also points out that the revision has been aimed toward a more natural and philosophical arrangement. Fractions are included immediately after whole numbers because it was considered that fractions needed to be used nearly as often as wholes. Since federal money is considered as decimal, it is treated with decimal fractions. These are followed in order by compound numbers and percentage.

Furthermore, Adams attempted to avoid any arrangement of content which might result in the processes becoming purely mechanical to the learner. Every effort has been made so to present the work as "to enable the ordinary pupil to understand everything as he advances." He holds that "no good results from presenting things, however excellent in themselves, if they are beyond the comprehension of the learner." Finally, he points out that he has attempted to omit antiquated materials which remain in many arithmetics merely for tradition's sake, and to substitute new and practical matter in their stead.

In addition to the preface, the book contains a few introductory "Suggestions to Teachers" written by one of the individuals who helped revise it. These suggestions emphasize the need for more adequate training of teachers and the need for the teacher to prepare each lesson carefully before meeting his classes. It is also suggested that since pupils need to know how to study, teachers should spend a little time in individual assistance and questioning with a view toward bringing about understanding on the part of the pupil. It is recommended that pupils be required to go through the processes at the time of the recitation rather than be permitted to depend on

the teacher to make the explanations or to help them through difficult parts, in order that they may learn more thoroughly and later may be able to use the knowledge gained when the occasion arises.

The following suggestion relative to the method of conducting the recitation is indeed interesting:

> Recitation by analysis will be found more conducive to thorough scholarship than adherence to any written questions. Let the class, or any member of the class, be able to commence at the beginning and go through with the entire lesson without any suggestion from the teacher—a thing that is perfectly practicable and easily attainable. Let the pupils be called on, at the pleasure of the teacher, in any part of the class, to go on with the recitation, even to proceed with it in the midst of a subject, the topic in no case ever being named by the teacher. They will thereby become accustomed to give their attention to the recitation, and they will be profited from it, besides securing habits of attention, which will be of incalculable value.

The order of procedure in treating each topic in this text differs a great deal from the common deductive order used most frequently during that early period. In each instance when a new process is introduced, one or more examples with detailed explanation precedes, instead of follows, the rule. In some cases a few simple concrete problems also precede it. The rule is then followed by more examples (problems) for practice. Often concrete, or written, problems of application immediately follow the rule, and drill problems come at the end of the list. This entire procedure is what the author calls his combination of the analytic and synthetic method—a combination of induction and deduction. The few simple, easy problems to be solved soon after definitions have been given enable the pupil to begin to see the general principle or principles involved. Then one or more problems solved and explained help to bring about complete understanding and thus lead up to the statement of the rule. The subsequent application of this rule to concrete problems and later to abstract problems is supposed to fix the principles and rules firmly in the pupil's mind.

Fundamental processes applied to whole numbers, including cancelation and common divisors, is the first major division of the book, followed in order by common fractions; decimal fractions and federal money; compound denominate numbers, including measures of extension and capacity; percentage, including such items as insurance, brokerage, profit and loss, discount, banking, partnership, and taxes; and ratio, proportion, alligation, exchange, duodecimals, involution and evolution, progressions, annuities, permutation, and mensuration. Scattered throughout the book at the end of sections are a few lists of miscellaneous and review problems. On many of the pages are found footnotes containing questions on the mechanical steps of a process.

The copy of Adams' book used in this study has been rebound. It has a brown board back with brown cloth binding. The paper is of very good quality. The entire book contains 312 numbered pages, each full page containing approximately 3¼ by 5⅝ inches of printed space. The type is a little smaller than that found in advanced ele-

mentary texts today. Solutions, explanations of examples, and footnote questions are set in very small type, while introductory material relating to rules is set in italics. Each full page of the work contains the approximate equivalent of 409 six-letter words.

The Common-School Arithmetic, by Chase, is another of the textbooks in which an attempt has been made to follow the inductive approach. The author suggests in the preface that *Colburn's First Lessons* would serve as an excellent introduction to this work. He has followed a plan of frequent repetition which he points out "is undoubtedly the best for indelibly impressing a familiarity with *principles* and *processes* on the mind of the pupil." In this he admits the influence of Pestalozzi, Colburn, Arnold, Ollendorff, and others.

This work is a revised edition of a former text by the author, and is designed to meet the needs in schools where a single arithmetical treatise is desirable, not only to give pupils a thorough knowledge of arithmetical operations but also to prepare them for business. The author points out several improvements which he has attempted to make over earlier texts: first, he has treated decimals and federal money in the same manner as whole numbers instead of as fractions; second, he has emphasized the dividend-divisor relationship of the numerator and the denominator in fractions; third, he has treated ratio extensively and explained its application in analyzing problems using multiplication and division; fourth, he has explained the principles underlying the fundamental processes only as they are applied to whole numbers and fractions, with the idea that this explanation will carry over into such items as denominate numbers; fifth, he has attempted to arrange the content in natural order so that each division would require familiarity with a previous division, and to leave nothing confronting the pupil at any time unexplained; sixth, he has included nearly 9,000 problems in the text (far more than in most arithmetics) and has attempted to distribute them so as to help the pupil to become thoroughly familiar with the principles, which are arranged in order of gradually increasing difficulty; seventh, he has attempted to exclude unnecessary rules and to add information not usually found in arithmetic texts, but which he deemed valuable; and eighth, he has attempted to introduce new and improved methods of operation of some of the rules, and to simplify the explanations of these methods and rules. The latter changes introduced by the author seem to be attempts merely to simplify rather than to propose new processes.

On a page preceding the preface in Chase's book are found a few "Hints to Teachers." In these it is stated that the object of the textbook should be to serve merely as a guide to the pupil and that:

> It is not sufficient that the reader should have a tolerable understanding of its contents, or that he should be able to repeat by rote all its arbitrary rules; but he should be taught to form his own rules, and to apply the principles which he has himself discovered, in every possible manner.

In regard to the procedure for accomplishing this objective, these suggestions are made:

At the end of every lesson, the books are all closed, and original questions are proposed by the teacher, to the class, and by each pupil to his left-hand neighbor. In this manner, the familiarity of each one with the subject of the lesson is thoroughly tested, and the teacher perceives at once what further explanation is required.

The classes are examined each day, on the preceding lesson, and are required frequently to review the part they have gone over. They are never allowed to enter on a new section, until they are perfectly familiar with the one they have left.

If the pupil finds any question contained in the book, too difficult, he is required to work out the statement with smaller numbers, until he perceives the course to be pursued.

The black-board is used at every recitation, and questions differing from those contained in the book, but involving the same principles, are solved and explained aloud, by different members of the class.

Let nothing be omitted, or hastily passed over.

The general order of presentation is to give a general explanation of the process, a list of abstract drill exercises, a statement of the rule, and, finally, additional drill problems. At the end of each major division of content is a list of written problems in concrete terms. An answer key has been included at the end of the text, but a few answers have been purposely omitted, so that it may be possible to determine whether students are relying too much on them.

The copy of Chase's text available for this study is bound in black cloth-covered board. It has apparently endured rough service, for it has been re-sewed and the back has been re-attached. The type is about the same size as that found in advanced elementary texts today. Footnotes are in smaller type, but are not numerous. All rules and some definitions are set in italics. The paper is of good quality. Exclusive of the answer key, the book contains 256 numbered pages, each full page containing about 3¼ by 5½ inches of printed space, and the approximate equivalent of 352 six-letter words.

In the publisher's notice introducing Perkins' *Elementary Arithmetic* is the following statement, which seems to reflect a concept of the purpose conceived for the teaching of arithmetic near the middle of the nineteenth century:

We, therefore, believe that the arithmetic which we submit, is peculiarly adapted to discipline the minds of those who study it, in the science of Numbers, and to advance them to a higher level of intellectual capability; in short, to *train* them fitly for advanced departments in Mathematics.

Although the text was originally published in 1845, the 1849 revision was used in this study. In the preface Perkins states that he has attempted to present arithmetic content concisely and clearly, and to correlate examples and questions with statistical and historical facts which all people should know in order to add an interest which was not found in abstract and purely numerical problems.

The general order of procedure in presenting a new aspect or process of arithmetic is as follows: definition of process and of terms involved, tables if they are needed, examples solved with detailed ex-

planation of all steps and rules, a few questions on the rules, drill problems, and written problems.

The first part of the book (considerably more than one half of it) is devoted to fundamental processes as applied to whole numbers and to these processes and reduction as applied to fractions, decimals, denominate numbers, and federal money. Approximately one third of the book is devoted to duodecimals, ratio, proportion, practice, percentage and interest, partial payments, discount, banking, commission, insurance, profit and loss, fellowship, taxes, and equation of payments. Extraction of roots is presented near the end of the book. The method used is that of having auxiliary columns. Diagrams and detailed explanations are used to clarify the procedure. Following the extraction of roots are arithmetical and geometrical progressions, alligation, mensuration, and miscellaneous written problems.

Perkins' book is bound in a grey board back with black leather binding. It contains 347 numbered pages, each full page of which contains approximately 3⅛ by 5 inches of printed space. The print is somewhat smaller than that found in the average school text today. Notes scattered throughout the book and questions on rules are set in very small type. Statements of all rules are set in italics. The paper is of good quality. A full page contains the approximate equivalent of 302 six-letter words.

Davies' *Arithmetic Designed for Academies and Schools* is the second of a two-book series. This volume was published in 1849, while the introductory book was not published until 1852. Although the introductory text was not published until the third period studied in this analysis, it is included within the period in which the advanced book falls (1821 to 1850) because it is believed they are outgrowths of the same period of thought. Since the introductory book is designed for beginners and the second book of the series is designed for more advanced students, it is assumed that the two books together cover about the same field as do the more general texts. Therefore these two arithmetics have been combined and treated as one book in the tables in this study.

In the preface to the advanced book Davies points out that arithmetic is both a science of numbers and a necessary knowledge in one's pursuit of vocations and business. Thus he has attempted:

1. To present to the young mind, unacquainted with the methods of exact reasoning, the elementary principles of arithmetic in their simplest form and combination.
2. To explain and illustrate the various applications of arithmetic in the transactions of business, and thus make known its great practical utility.

The method of attaining the first objective, as set forth by the author, is:

1. To present to the mind every new idea by a simple question, and then to express the idea in general terms under the form of a *definition* or *principle*.
2. When a sufficient number of ideas are thus fixed in the

mind, they are combined, forming a proposition or rule; so that the separate elements are arranged in the order of exact reasoning, as fast as they are learned.

3. An entire system of Mental or Oral Arithmetic has been carried forward in connection with the text, by means of a connected series of questions placed at the bottom of each page; and if these, or their equivalents, are carefully put by the teacher, the pupil will understand the reasoning in every process, and at the same time cultivate the powers of analysis and abstraction.

4. The better to obtain these objectives, the Arithmetic has been divided into paragraphs or sections, each containing a number of connected principles—and these paragraphs constitute a series of dependent propositions that make up the entire system of reasoning which the work develops.

The general order of content for any particular topic in the book is: simple example with explanation, definition of process, simple drill exercises, explanation of terms involved, tables where they are appropriate, further drill exercises, drill and written exercises combined, followed by more complex examples, explanation, and exercises. Near the end of the text are a number of miscellaneous written problems, and finally a simple practical system of bookkeeping is included.

The copy of the book used in this analysis has a brown board back with a black leather binding. It contains 360 numbered pages, each full page of which contains about 3 by 5¼ inches of printed space and the approximate equivalent of 372 six-letter words. The paper does not seem to be of very good quality and is brown with age. The print is relatively small for an elementary school textbook, and questions included as footnotes frequently are set in very small type. All rules are set in italics.

In the first part of Davies' *First Lessons in Arithmetic* the pupil is introduced to counting and is advanced step by step through all the simple combinations. The units indicated by Arabic numerals are represented by stars as well as by numbers in the first few pages of the book and it is recommended that the stars be counted by the pupils in each case.

Treatment of the combinations is followed by a treatment of fractional units. The lessons are arranged with the purpose of illustrating "that the science of numbers is but the comparison of all numbers with the unit one."

Part II of the *First Lessons* is designed to train pupils to give the sums and differences of simple numbers at sight. Likewise, the pupils are taught to give the results of simple subtractions and to give products and quotients involving the tables up to the 12's at sight. Davies says:

> This is all to be done by *the simple process* of reading; and the method consists, 1st. In teaching the arithmetical alphabet, and 2ndly. In teaching the combinations of the alphabet, which become the exponents, or signs, of ideas.

The book used in this study has the same type of binding, paper, and size of print as does the advanced book. It has 198 numbered pages, each full page containing about 2¾ by 4⅞ inches of printed space and the approximate equivalent of 322 six-letter words.

TECHNIQUE OF PROCEDURE

As has been pointed out in the first bulletin of this series on the quantitative-qualitative analysis of arithmetic textbooks, one of the chief purposes of the study has been to discover variations and trends in the inclusion and treatment of aspects of content. Therefore, introductions and prefaces to the texts were analyzed carefully, and the entire content of each book was surveyed to determine the author's purposes, attempted variations, basic pedagogical theories, and suggested methods of presentation.

Each detailed aspect of content in each of the books studied was also described on a separate card, together with the amount of space given to the item in the book. This amount of space was determined by measuring the pages and portions of pages given to the item to the nearest hundredths decimally. When all items or detailed aspects of content found in each of the books from the period from 1821 to 1850 had thus been described on separate cards, the cards were sorted according to major aspects of content. The outline developed in preparing the first unit of the study served as a guide for sorting the cards made out for the books in the second period, the information contained on the sorted cards being tabulated according to both major topics and books. The amounts of measured space given to each single major topic in each book were combined and these amounts set up in table form showing the names of the topics and the total amounts of measured space given to them in the various books.

Since the books analyzed vary considerably in total number of pages and in size of page, the actual measured pages in each book given to a topic are far from comparable, and therefore the numbers had to be converted to a standard measure. In this study, a full printed page containing the equivalent of 400 six-letter words was used as that standard, and measured space in each of the 13 books was converted to this basis.

RESULTS OF THE ANALYSIS

Space given to each topic.—Table I gives the number of standard 400-word (six-letter) pages in these arithmetics, classified according to 37 major topics and a number of subtopics. These classifications are approximately the same as those used in the analysis of textbooks of the first period of this study, but a few minor differences were made necessary because of changes in content or emphasis in the study of arithmetic in the second period. Since the figures in this table are on a comparable basis, the relative number of pages given to each topic in the various books as well as that given to the various topics within any one book may be studied.

Zeros are used in the table to indicate either that a book contains no treatment of a certain topic or that any treatment given to that topic is so indirect or interwoven with other phases of content that it cannot be separated for purposes of measurement. Zeros listed under major topics usually indicate that no separate treatment is given to the topic, while those listed under subtopics more often indicate indirect or interwoven treatment. For example, in the column

devoted to Colburn's book, there is no material included under the subtopics "addition of fractions" and "subtraction of fractions." This is because the treatment of the two subjects is so interwoven that the subjects cannot be satisfactorily separated, and the material is therefore included under the combined heading "addition and subtraction of fractions."

According to Table I, all of the 12 books studied in the second period deal with the major topics of arithmetic symbols, total numeration, total fundamental processes in whole numbers, total vulgar (common) fractions, measures (tables and their uses), and total percentage; while Colburn's text is the only one of the books that does not deal with arithmetic (general aspects), total decimals, total compound denominate numbers, proportion, total powers and roots, total practice, and total progression, and DeMorgan's is the only one that does not deal with miscellaneous written problems. On the other hand, only two books deal with longitude and time, and analysis, while only three include bills and accounts, imports and exports, algebra, taxes, and miscellaneous drill problems. On an average, approximately eight of the 12 books deal with each of the topics, although, as had been noted, there is a wide range in number of books treating each of the topics.

Another point brought out in Table I is the wide variation in number of topics dealt with in each book. Of the 37 major topics, Adams gives specific space to 32, more than any other book on the list; Davies treats 31 of the topics (only 10 of which are found in the elementary text); Chase, 30; Thompson, 28; Guthrie, 27; Talbott, 26; Ostrander, 25; Smiley, 24; Perkins, 24; DeMorgan, 22; Hassler, 20; and Colburn, only 9. The book which treats the fewest topics is also the shortest book in number of standard pages, while Hassler's *Elements of Arithmetic*, the book treating the next to the fewest topics, is one of the longest books in the group studied. Similar variations are found in the amount of space given to subtopics.

The range in number of standard pages given to each major topic by the various books is also very great. Guthrie's book, for example, gives only 9.15 standard pages to total fundamental processes in whole numbers, while Davies' series gives 109.74 pages to the topic. Again, in dealing with total vulgar (common) fractions, the range is from 6.60 standard pages in Smiley's text, to 78.03 in Davies.' The topic, total compound denominate numbers, is not included in Colburn's book, while Talbott, Adams, Perkins, and Davies give it more than 30 pages each. Three books omit partial payments, while Perkins' book devotes 11.12 pages to the topic; and, although 10 of the 12 books omit analysis, Chase gives the topic as much as 8.80 standard pages.

In all of the books combined there are a total of 2,389.07 standard 400 (six-letter) word pages. Of this total, 421.61 pages are devoted to fundamental processes in whole numbers, 280.76 pages to common fractions, 259.08 to compound denominate numbers, 205.19 to percentage, 151.11 to proportion, 139.24 to powers and roots, 118.01 to decimals, and 101.74 to miscellaneous written problems. No other major topic is given more than 100 pages of treatment in all the books com-

TABLE I. NUMBER OF 400-WORD PAGES GIVEN TO EACH TOPIC IN ARITHMETIC TEXTBOOKS FROM 1821 TO 1850

Topic	Colburn, Warren, *Intellectual Arithmetic*, 1821	Thompson, Zadock, *The Youth's Assistant in Practical Arithmetic*, 1825	Hassler, F. R., *Elements of Arithmetic*, 1826	Smiley, Thomas T., *The New Federal Calculator*, 1828	Ostrander, Tobias, *The Elements of Numbers*, 1829	Guthrie, Jesse, *The American Schoolmaster's Assistant*, 1834	DeMorgan, Augustus, *The Elements of Arithmetic*, 1835	Talbott, John L., *The Western Practical Arithmetic*, 1841	Adams, Daniel, *Adams' New Arithmetic*, 1848	Chase, Pliny E., *The Common-School Arithmetic*, 1848	Perkins, George R., *An Elementary Arithmetic*, 1849	Davies, Charles, *Arithmetic*, 1849; and *First Lessons in Arithmetic*, 1852	Subtotal	Total
	9	10	11	12	13	14	15	16	17	18	19	20		
Arithmetic symbols	.52	.45	1.25	.09	.83	.69	.58	.27	.77	.75	1.13	.70		8.03
Arithmetic (general aspects)	0	1.05	3.43	.14	.26	.15	.29	.27	.20	.26	.19	1.01		7.25
Total numeration	.87	3.21	2.59	1.89	2.64	2.90	8.34	6.08	6.85	7.13	5.75	11.40		59.65
Numeration by words and Arabic symbols	.87	2.84	2.07	1.89	2.64	2.90	8.34	5.53	6.34	7.13	5.07	10.32	55.94	
Numeration by Roman numerals	0	.37	.52	0	0	0	0	.55	.51	0	.68	1.08	3.71	
Total fundamental processes in whole numbers	41.19	23.09	30.38	15.52	15.06	9.15	28.32	25.44	50.24	39.78	33.70	109.74		421.61
Addition and subtraction of whole numbers	.67	0	1.55	0	.31	0	.83	0	1.64	1.58	.91	1.86	9.35	
Addition of whole numbers	11.81	6.35	5.59	3.25	3.16	1.23	3.26	2.24	6.55	5.95	6.43	29.17	84.99	
Subtraction of whole numbers	2.80	3.44	5.23	1.94	1.35	.84	3.43	2.20	5.32	7.79	5.75	16.50	56.59	
Multiplication and division of whole numbers	0	0	0	0	0	0	0	11.16	4.30	1.85	0	0	17.31	
Multiplication of whole numbers	10.16	6.80	7.66	4.74	6.00	2.51	6.36	3.48	13.76	7.96	7.83	27.48	104.74	
Division of whole numbers	15.75	6.50	10.35	5.59	4.24	4.57	14.44	6.36	18.67	14.65	12.78	34.73	148.63	

TABLE I—CONTINUED

Total vulgar (common) fractions	57.30	10.61	32.17	6.60	9.92	6.94	10.64	10.20	27.16	13.68	17.51	78.03		280.76
Vulgar fractions (general)	13.43	8.15	15.78	4.24	6.62	4.08	6.19	5.81	14.22	10.56	12.48	51.37	152.93	
Aliquot parts	0	.52	0	.32	.72	.15	0	.69	.72	.22	.30	.50	4.14	
Addition and subtraction of fractions	1.58	0	.31	0	0	0	.12	0	.46	0	0	0	2.47	
Addition of fractions	0	.67	2.48	.72	.98	.79	.58	1.97	.46	.84	1.32	5.80	16.61	
Subtraction of fractions	0	.45	3.67	.68	.72	.64	0	.91	.61	.88	.83	4.27	13.66	
Multiplication and division of fractions	11.42	0	0	0	0	0	0	0	0	0	0	.23	11.65	
Multiplication of fractions	24.57	.52	4.55	.32	.47	.69	1.98	.41	5.78	.70	1.63	7.05	48.67	
Division of fractions	6.30	.30	5.38	.32	.41	.59	1.77	.41	4.91	.48	.95	8.81	30.63	
Total decimals	0	6.36	13.86	4.93	7.65	4.13	20.51	7.32	15.40	9.86	12.41	15.58		118.01
Decimals (general)	0	3.29	3.05	2.80	1.60	2.06	10.28	3.29	10.89	4.49	7.41	7.58	56.74	
Addition of decimals	0	.90	1.40	.50	1.60	.49	.54	.37	.77	0	1.10	1.81	9.48	
Subtraction of decimals	0	.45	1.24	.36	1.04	.15	.41	.23	0	0	.53	1.12	5.53	
Multiplication of decimals	0	.75	4.24	.77	1.29	.59	7.51	.46	1.59	3.21	1.10	2.05	23.56	
Division of decimals	0	.97	3.93	.50	2.12	.84	1.77	2.97	2.15	2.16	2.27	3.02	22.70	
Duodecimals	0	1.42	2.02	1.98	1.04	2.21	0	1.37	3.07	2.20	2.53	2.33		20.17
Federal money	0	7.03	0	1.04	3.57	5.41	0	5.95	3.99	1.94	4.95	14.59		48.47
Measures (tables and their uses)	1.97	5.98	6.52	3.34	2.43	3.88	4.58	2.52	6.50	5.19	9.30	14.60		66.81
Total compound denominate numbers	0	23.40	11.17	25.80	25.82	13.86	10.31	30.83	31.46	15.67	30.13	40.63		259.08
Compound denominate numbers (general)	0	1.87	1.91	0	0	.15	2.48	0	3.38	7.57	4.69	5.75	27.80	
Addition of compound denominate numbers	0	5.16	1.91	5.73	4.45	1.52	.66	4.21	4.81	1.32	3.74	5.44	38.95	
Subtraction of compound denominate numbers	0	3.14	1.29	4.69	3.67	1.72	1.61	4.57	3.68	1.06	2.08	3.16	30.67	
Multiplication of compound denominate numbers	0	1.57	2.28	6.72	3.52	3.34	.78	5.63	2.76	.92	1.89	5.91	35.32	
Division of compound denominate numbers	0	1.87	3.78	2.44	2.28	2.36	1.77	4.53	2.30	1.32	2.42	4.56	29.63	
Reduction of compound denominate numbers	0	9.79	0	6.22	11.90	4.77	3.01	11.89	14.53	3.48	15.31	15.81	96.71	
Bills and accounts	0	0	0	0	0	.84	0	0	2.10	0	0	1.58		4.52
Exchange	0	.15	3.73	4.46	2.43	14.11	0	1.01	4.96	1.50	3.06	1.72		37.13

TABLE I—CONTINUED

Topic	9	10	11	12	13	14	15	16	17	18	19	20	Sub-total	Total
Total geometric forms	0	8.59	0	0	9.58	18.08	3.51	9.74	5.57	9.89	7.86	10.88		83.70
Geometric forms (general)	0	2.39	0	0	3.89	9.14	.58	3.70	2.40	2.11	1.17	3.72	29.10	
Areas of geometric forms.	0	4.11	0	0	2.69	2.26	2.39	2.61	1.53	1.36	5.22	3.30	25.47	
Volumes of geometric forms	0	2.09	0	0	3.00	6.68	.54	3.43	1.64	6.42	1.47	3.86	29.13	
Total percentage	.20	18.24	9.01	20.11	16.67	30.11	6.89	11.99	29.01	17.73	20.08	25.15		205.19
Percentage and its application (general)	0	0	0	0	0	.93	.17	0	6.96	1.41	1.81	1.77	13.05	
Commission, brokerage, and insurance	0	1.05	0	.90	.26	.98	.12	.96	2.71	1.67	1.29	1.63	11.57	
Insurance	0	.15	0	0	.57	.20	.12	0	3.43	1.01	.64	1.16	7.28	
Profit and loss	0	1.87	0	3.20	3.21	6.73	.04	2.84	.41	.97	1.81	2.51	23.59	
Discount	0	2.02	0	1.76	1.71	2.16	.58	1.83	1.13	2.33	3.82	5.44	22.78	
Interest (general)	0	.75	0	.68	.78	.44	1.86	.59	2.35	.22	.23	.93	8.83	
Simple interest	.20	8.52	1.66	4.74	8.33	7.91	3.01	4.76	10.49	3.21	9.57	10.97	73.37	
Simple interest in annuities, etc.	0	1.64	0	0	.93	3.49	0	0	0	2.68	0	0	8.74	
Compound interest	0	2.24	3.83	4.28	.88	3.29	.99	1.01	1.33	1.19	.91	.74	20.69	
Compound interest in annuities or pensions in arrears	0	0	3.52	4.10	0	2.26	0	0	.20	2.64	0	0	12.72	
Perpetuities or annuities forever	0	0	0	.45	0	1.72	0	0	0	.40	0	0	2.57	
Partial payments	0	.90	0	.63	.52	3.44	0	.96	5.32	3.43	11.12	4.09		30.41
Ratio	0	0	1.60	0	0	0	.50	0	2.51	1.94	.72	1.12		8.39
Alligation	0	5.68	5.95	2.93	3.31	0	.37	0	4.35	4.93	4.73	4.70		36.95
Proportion	0	16.52	33.64	9.88	5.43	9.88	8.21	20.12	9.05	6.34	12.74	19.30		151.11
Total partnership	0	2.32	0	2.21	3.88	4.92	1.77	2.74	2.00	2.46	3.89	2.65		28.84
Partnership (general)	0	.15	0	.18	0	3.15	.45	.27	.31	.04	.15	1.07	5.77	
Simple fellowship or partnership	0	1.27	0	1.80	2.79	1.23	1.32	1.33	1.23	1.01	2.23	.65	14.86	
Double fellowship or partnership	0	.90	0	.23	1.09	.54	0	1.14	.46	1.41	1.51	.93	8.21	
Longitude and time	0	0	0	0	0	0	0	0	1.89	0	0	.98		2.87
Total powers and roots	0	17.49	10.24	5.50	10.30	12.78	9.86	20.90	14.73	7.96	19.20	10.28		139.24

TABLE I—CONTINUED

Powers and roots (general)	0	0	.05	0	0	.64	0	0	.26	0	0	0	.95	
Involution or raising of powers	0	3.21	2.74	.99	.57	.93	.78	2.38	1.84	.22	5.52	1.21	20.39	
Evolution or extraction of roots	0	9.72	7.45	4.51	4.71	4.87	9.08	17.24	10.84	7.74	11.15	9.07	96.38	
Uses of square root	0	3.59	0	0	4.24	4.37	0	1.28	1.64	0	1.40	0	16.52	
Uses of cube root	0	.97	0	0	.78	1.97	0	0	.15	0	1.13	0	5.00	
Total practice	0	1.57	2.59	5.87	7.24	2.75	3.71	4.48	5.22	.62	1.86	2.09		38.00
Practice (general)	0	.30	.62	.41	.10	.34	0	.14	.26	.09	.08	.09	2.43	
Practice in finding total value of goods when price and quantity are given	0	1.27	1.97	5.46	7.14	2.41	3.71	4.34	4.96	.53	1.78	2.00	35.57	
Barter	2.09	1.64	0	1.89	1.97	1.87	0	2.33	0	0	0	0		11.79
Tare, trett, cloff, etc.	0	2.02	.21	3.97	0	2.16	.08	2.10	.51	.26	0	2.65		13.96
Imports and exports	0	0	0	0	0	0	0	0	2.05	.62	0	1.49		4.16
Total progression	0	5.09	20.55	3.11	4.45	4.42	4.87	7.13	15.55	8.00	4.95	5.63		83.75
Arithmetic progression	0	2.62	9.68	1.80	1.91	2.06	1.11	3.20	4.71	4.22	2.19	3.21	36.71	
Geometric progression	0	2.47	10.87	1.31	2.54	2.36	3.76	3.93	10.84	3.78	2.76	2.42	47.04	
Position or rule of false	0	3.21	0	3.16	3.67	2.90	0	1.05	0	0	0	0		13.99
Permutations and combinations	0	1.35	0	.90	.52	.98	3.22	0	.41	.57	0	0		7.95
Algebra	0	0	4.04	0	0	0	16.05	.78	0	0	0	0		20.87
Plane geometry	0	.97	0	0	0	.34	.33	0	.05	0	0	0		1.69
Business forms	0	9.27	0	0	8.38	0	0	10.98	3.48	1.80	0	8.93		42.84
Banking	0	0	0	0	0	0	0	0	1.28	.79	.30	.23		2.60
Taxes	0	0	0	0	0	0	0	0	1.64	0	1.55	1.91		5.10
Analysis	0	0	0	0	0	0	0	0	3.63	8.80	0	0		12.43
Miscellaneous written problems	12.09	4.93	7.92	5.95	11.95	6.49	0	4.48	9.97	7.88	19.62	10.45		101.74
Miscellaneous drill problems.	0	0	0	0	0	.29	0	0	0	.62	0	3.28		4.19
Other miscellaneous items	2.64	.22	0	0	0	0	.41	1.14	0	.44	0	.98		5.83
Total 400-word pages	118.87	182.76	202.87	131.90	159.52	165.68	143.35	192.18	270.92	183.04	229.28	408.70	2,389.07	2,389.07

bined. Among the subtopics, more space seems to have been required to present the processes of multiplication and division of whole numbers than to present those of addition and subtraction. Vulgar fractions (general) and division of whole numbers are given considerably more space than any other subtopics.

Barter, position or rule of false, and algebra are not found as topics in the books published after 1841; while longitude and time, imports and exports, banking, taxes, and analysis appear for the first time in books published after that date.

The difference in length of the various textbooks makes it difficult to determine the relative emphasis given by them to the different topics. This difference in length is usually due to one of two causes: (1) a difference in ability of the various authors to express themselves clearly and concisely in the statement of principles and rules and their definitions and explanations or in their written problems; and (2) a difference in the extent of treatment of a topic, that is, the number of exceptions, special cases, practice materials, etc. Therefore, assuming that the per cent of space given to a topic is an indication of the author's concept of its importance in comparison with all other topics treated in the book, Table II is presented, giving the information found in Table I, but presenting the number of standard pages devoted to each topic in terms of percentage of total number of pages in the book.

According to Table II, total fundamental processes in whole numbers is emphasized much more than any other topic, as it is given 17.65 per cent of the space in all books combined, almost 6 per cent more space than is given to any other topic. Total vulgar (common) fractions is given 11.75 per cent of the space and total compound denominate numbers 10.84 per cent, but no other topic receives as much as 10 per cent of the space in all books combined. Both Colburn and Davies give far more emphasis than the other authors to the first two of these topics, while Guthrie gives considerably less than average, but there is not a wide variation in the percentage of space given to each of these topics by the other nine books. Since Colburn's book deals with considerably fewer topics than any of the other texts, it is to be expected that it would give more than the average percentage of space to many of those topics which are included, but Davies includes most of the 37 major topics.

The smallest percentage of space given to any major topic by all books combined, .07 per cent, is given to plane geometry, while banking is given only .11 per cent of the space, and longitude and time only .12 per cent. None of these topics, however, are treated by more than four of the books. The smallest average amount of space given to any one major topic treated by all 12 books is .34 per cent, given to arithmetic symbols.

In general, there is not a wide difference in the amount of emphasis given to the topics by the various books. In a few cases, however, there are books which give a seemingly disproportionate amount of space to a topic. For example, Guthrie gives more than three times as much space to geometric forms (10.91 per cent), more than twice as much to total percentage (18.17 per cent), and more

TABLE II. PER CENT OF 400-WORD PAGES GIVEN TO EACH TOPIC IN ARITHMETIC TEXTBOOKS FROM 1821 TO 1850

Topic	Colburn, Warren, *Intellectual Arithmetic*, 1821	Thompson, Zadock, *The Youth's Assistant in Practical Arithmetic*, 1825	Hassler, F. R., *Elements of Arithmetic*, 1826	Smiley, Thomas T., *The New Federal Calculator*, 1828	Ostrander, Tobias, *The Elements of Numbers*, 1829	Guthrie, Jesse, *The American Schoolmaster's Assistant*, 1834	DeMorgan, Augustus, *The Elements of Arithmetic*, 1835	Talbott, John L., *The Western Practical Arithmetic*, 1841	Adams, Daniel, *Adams' New Arithmetic*, 1848	Chase, Pliny E., *The Common-School Arithmetic*, 1848	Perkins, George R., *An Elementary Arithmetic*, 1849	Davies, Charles, *Arithmetic*, 1849; and *First Lessons in Arithmetic*, 1852	Subtotal	Total
	9	10	11	12	13	14	15	16	17	18	19	20		
Arithmetic symbols	.44	.25	.62	.07	.52	.42	.40	.14	.28	.41	.49	.17		.34
Arithmetic (general aspects)	0	.57	1.69	.11	.16	.09	.20	.14	.07	.14	.08	.25		.30
Total numeration	.73	1.76	1.28	1.43	1.65	1.75	5.82	3.16	2.53	3.90	2.51	2.79		2.50
Numeration by words and Arabic symbols	.73	1.55	1.02	1.43	1.65	1.75	5.82	2.88	2.34	3.90	2.21	2.53	2.34	
Numeration by Roman numerals	0	.20	.26	0	0	0	0	.29	.19	0	.30	.26	.16	
Total fundamental processes in whole numbers	34.65	12.63	14.97	11.77	9.44	5.52	19.76	13.24	18.54	21.73	14.70	26.85		17.65
Addition and subtraction of whole numbers	.56	0	.76	0	.19	0	.58	0	.61	.86	.40	.46	.39	
Addition of whole numbers	9.94	3.47	2.76	2.46	1.98	.74	2.27	1.17	2.42	3.25	2.80	7.14	3.56	
Subtraction of whole numbers	2.36	1.88	2.58	1.47	.85	.51	2.39	1.14	1.96	4.26	2.51	4.04	2.37	
Multiplication and division of whole numbers	0	0	0	0	0	0	0	5.81	1.59	1.01	0	0	.72	
Multiplication of whole numbers	8.55	3.72	3.78	3.59	3.76	1.51	4.44	1.81	5.08	4.35	3.41	6.72	4.38	
Division of whole numbers	13.25	3.56	5.10	4.24	2.66	2.76	10.07	3.31	6.89	8.00	5.57	8.50	6.22	

TABLE II—CONTINUED

Topic	9	10	11	12	13	14	15	16	17	18	19	20	Sub-total	Total
Total vulgar (common) fractions	48.20	5.81	15.86	5.00	6.22	4.19	7.42	5.31	10.03	7.47	7.64	19.09		11.75
Vulgar fractions (general)	11.30	4.46	7.78	3.21	4.15	2.46	4.32	3.02	5.25	5.77	5.44	12.57	6.40	
Aliquot parts	0	.28	0	.24	.45	.09	0	.36	.27	.12	.13	.12	.17	
Addition and subtraction of fractions	1.33	0	.15	0	0	0	.08	0	.17	0	0	0	.10	
Addition of fractions	0	.37	1.22	.55	.61	.48	.40	1.03	.17	.46	.58	1.42	.70	
Subtraction of fractions	0	.25	1.81	.52	.45	.39	0	.47	.23	.48	.36	1.04	.57	
Multiplication and division of fractions	9.61	0	0	0	0	0	0	0	0	0	0	.06	.49	
Multiplication of fractions	20.67	.28	2.24	.24	.29	.42	1.38	.21	2.13	.38	.71	1.72	2.04	
Division of fractions	5.30	.16	2.65	.24	.26	.36	1.23	.21	1.81	.26	.41	2.16	1.28	
Total decimals	0	3.48	6.83	3.74	4.80	2.49	14.31	3.81	5.68	5.39	5.41	3.81		4.94
Decimals (general)	0	1.80	1.50	2.12	1.00	1.24	7.17	1.71	4.02	2.45	3.23	1.85	2.37	
Addition of decimals	0	.49	.69	.38	1.00	.30	.38	.19	.28	0	.48	.44	.40	
Subtraction of decimals	0	.25	.61	.27	.65	.09	.29	.12	0	0	.23	.27	.23	
Multiplication of decimals	0	.41	2.09	.58	.81	.36	5.24	.24	.59	1.75	.48	.50	.99	
Division of decimals	0	.53	1.94	.38	1.33	.51	1.23	1.55	.79	1.18	.99	.74	.95	
Duodecimals	0	.78	1.00	1.50	.65	1.33	0	.71	1.13	1.20	1.10	.57		.84
Federal money	0	3.85	0	.79	2.24	3.27	0	3.10	1.47	1.06	2.16	3.57		2.03
Measures (tables and their uses)	1.66	3.27	3.21	2.53	1.52	2.34	3.19	1.31	2.40	2.84	4.06	3.57		2.80
Total compound denominate numbers	0	12.80	5.51	19.56	16.19	8.37	7.19	16.04	11.61	8.56	13.14	9.94		10.84
Compound denominate numbers (general)	0	1.02	.94	0	0	.09	1.73	0	1.25	4.14	2.05	1.41	1.16	
Addition of compound denominate numbers	0	2.82	.94	4.34	2.79	.92	.46	2.19	1.78	.72	1.63	1.33	1.63	
Subtraction of compound denominate numbers	0	1.72	.64	3.56	2.30	1.04	1.12	2.38	1.36	.58	.91	.77	1.28	
Multiplication of compound denominate numbers	0	.86	1.12	5.09	2.21	2.02	.54	2.93	1.02	.50	.82	1.45	1.48	
Division of compound denominate numbers	0	1.02	1.86	1.85	1.43	1.42	1.23	2.36	.85	.72	1.06	1.12	1.24	

TABLE II—CONTINUED

Reduction of compound denominate numbers	0	5.36	0	4.72	7.46	2.88	2.10	6.19	5.36	1.90	6.68	3.87	4.05	
Bills and accounts	0	0	0	0	0	.51	0	0	.78	0	0	.39		.19
Exchange	0	.08	1.84	3.38	1.52	8.52	0	.53	1.83	.82	1.33	.42		1.55
Geometric forms	0	4.70	0	0	6.01	10.91	2.45	5.07	2.06	5.40	3.43	2.66		3.50
Geometric forms (general)	0	1.31	0	0	2.44	5.52	.40	1.93	.89	1.15	.51	.91	1.22	
Areas of geometric forms	0	2.25	0	0	1.69	1.36	1.67	1.36	.56	.74	2.28	.81	1.07	
Volumes of geometric forms	0	1.14	0	0	1.88	4.03	.38	1.78	.61	3.51	.64	.94	1.22	
Total percentage	.17	9.98	4.44	15.25	10.45	18.17	4.81	6.24	10.71	9.69	8.76	6.15		8.59
Percentage and its application (general)	0	0	0	0	0	.56	.12	0	2.57	.77	.79	.43	.55	
Commission, brokerage, and insurance	0	.57	0	.68	.16	.59	.08	.50	1.00	.91	.56	.40	.48	
Insurance	0	.08	0	0	.36	.12	.08	0	1.27	.55	.28	.28	.30	
Profit and loss	0	1.02	0	2.43	2.01	4.06	.03	1.48	.15	.53	.79	.61	.99	
Discount	0	1.11	0	1.33	1.07	1.30	.40	.95	.42	1.27	1.67	1.33	.95	
Interest (general)	0	.41	0	.52	.49	.27	1.30	.31	.87	.12	.10	.23	.37	
Simple interest	.17	4.66	.82	3.59	5.22	4.77	2.10	2.48	3.87	1.75	4.17	2.68	3.07	
Simple interest in annuities, etc	0	.90	0	0	.58	2.11	0	0	0	1.46	0	0	.37	
Compound interest	0	1.23	1.89	3.24	.55	1.99	.69	.53	.49	.65	.40	.18	.87	
Compound interest in annuities or pensions in arrears	0	0	1.74	3.11	0	1.36	0	0	.07	1.44	0	0	.53	
Perpetuities or annuities forever	0	0	0	.34	0	1.04	0	0	0	.22	0	0	.11	
Partial payments	0	.49	0	.48	.33	2.08	0	.50	1.96	1.87	4.85	1.00		1.27
Ratio	0	0	.79	0	0	0	.35	0	.93	1.06	.31	.27		.35
Alligation	0	3.11	2.93	2.22	2.07	0	.26	0	1.61	2.69	2.06	1.15		1.55
Proportion	0	9.04	16.58	7.49	3.40	5.96	5.73	10.47	3.34	3.46	5.56	4.72		6.33
Total partnership	0	1.27	0	1.68	2.43	2.97	1.23	1.43	.74	1.34	1.70	.65		1.21
Partnership (general)	0	.08	0	.14	0	1.90	.31	.14	.11	.02	.07	.26	.24	
Simple fellowship or partnership	0	.69	0	1.36	1.75	.74	.92	.69	.45	.55	.97	.16	.62	

TABLE II—CONTINUED

Topic	9	10	11	12	13	14	15	16	17	18	19	20	Sub-total	Total
Double fellowship or partnership	0	.49	0	.17	.68	.33	0	.59	.17	.77	.66	.23	.34	
Longitude and time	0	0	0	0	0	0	0	0	.70	0	0	.24		.12
Total powers and roots	0	9.57	5.05	4.17	6.46	7.71	6.88	10.88	5.44	4.35	8.37	2.52		5.83
Powers and roots (general)	0	0	.02	0	0	.39	0	0	.10	0	0	0	.04	
Involution or raising of powers	0	1.76	1.35	.75	.36	.56	.54	1.24	.68	.12	2.41	.30	.85	
Evolution or extraction of roots	0	5.32	3.67	3.42	2.95	2.94	6.33	8.97	4.00	4.23	4.86	2.22	4.03	
Uses of square root	0	1.96	0	0	2.66	2.64	0	.67	.61	0	.61	0	.69	
Uses of cube root	0	.53	0	0	.49	1.19	0	0	.06	0	.49	0	.21	
Total practice	0	.86	1.28	4.45	4.54	1.66	2.59	2.33	1.93	.34	.81	.51		1.59
Practice (general)	0	.16	.31	.31	.06	.21	0	.07	.10	.05	.03	.02	.10	
Practice in finding total value of goods when price and quantity are given	0	.69	.97	4.14	4.48	1.45	2.59	2.26	1.83	.29	.78	.49	1.49	
Barter	1.76	.90	0	1.43	1.23	1.13	0	1.21	0	0	0	0		.49
Tare, trett, cloff, etc.	0	1.11	.10	3.01	0	1.30	.06	1.09	.19	.14	0	.65		.58
Imports and exports	0	0	0	0	0	0	0	0	.76	.34	0	.36		.17
Total progression	0	2.79	10.13	2.36	2.79	2.67	3.40	3.71	5.74	4.37	2.16	1.38		3.51
Arithmetic progression	0	1.43	4.77	1.36	1.20	1.24	.77	1.67	1.74	2.31	.96	.79	1.54	
Geometric progression	0	1.35	5.36	.99	1.59	1.42	2.62	2.04	4.00	2.07	1.20	.59	1.97	
Position or rule of false	0	1.76	0	2.40	2.30	1.75	0	.55	0	0	0	0		.59
Permutations and combinations	0	.74	0	.68	.33	.59	2.25	0	.15	.31	0	0		.33
Algebra	0	0	1.99	0	0	0	11.20	.41	0	0	0	0		.87
Plane geometry	0	.53	0	0	0	.21	.23	0	.02	0	0	0		.07
Business forms	0	5.07	0	0	5.25	0	0	5.71	1.28	.98	0	2.18		1.79
Banking	0	0	0	0	0	0	0	0	.47	.43	.13	.06		.11

TABLE II—CONTINUED

Taxes	0	0	0	0	0	0	0	0	.61	0	.68	.47		.21
Analysis	0	0	0	0	0	0	0	0	1.34	4.81	0	0		.52
Miscellaneous written problems	10.17	2.70	3.90	4.51	7.49	3.92	0	2.33	3.68	4.31	8.56	2.56		4.26
Miscellaneous drill problems	0	0	0	0	0	.18	0	0	0	.34	0	.80		.18
Other miscellaneous items	2.22	.12	0	0	0	0	.29	.59	0	.24	0	.24		.24
Total per cent	100.00	100.02	100.00	100.01	99.99	100.01	100.02	100.01	100.01	99.99	100.00	99.99	99.97	99.99

than five times as much to exchange (8.52 per cent) as do all books combined. Hassler gives 1.69 per cent of space to arithmetic (general aspects), while the other 10 books treating the subject give only .07 to .57 per cent. This author also gives 16.58 per cent of space to proportion and 10.13 per cent to the study of total progression, while none of the other 10 books dealing with the topic give them more than half as much emphasis. DeMorgan gives total decimals more than twice as much emphasis as do any of the other 10 books treating the topic and more than three times as much as all books combined give it. This author also gives a disproportionate amount of space to permutations and combinations and to algebra, when compared with the other texts. The first of these is treated by only seven books, which give an average of .33 per cent of space to the topic, and algebra is treated by only three books, which give it .87 per cent of space. DeMorgan, however, gives these topics 2.25 and 11.20 per cent of space, respectively. Perkins gives more than three times as much space to partial payments as do all the books combined.

Very few trends are evident in Table II. As has been mentioned in connection with Table I, several of the topics are not found in books published before 1841, while others are not included after that date. There is an indication that certain topics and subtopics gained in popularity as subjects to be included in arithmetics during the period from 1821 to 1850. Among these are total numeration, geometric forms, partial payments, and miscellaneous drill problems. On the other hand, a few topics, such as permutations and combinations, and plane geometry, seem to have lost in favor during the period.

On the whole, the kind of topics treated most thoroughly indicates that most of the books studied have been written primarily for the intermediate or grammar grades.

Space given to each type of content.—Further analysis of the original tabulations was made to discover the amount of space given to certain types of content, such as definitions, rules, and problems, irrespective of the topics with which they deal. Since it was almost impossible to classify some of the material under only one of these types, some of the content has been included under more than one heading. For example, space given to definitions was recorded under that heading even though the content was also classified under the heading of whole numbers, fractions, addition, etc. For this reason, in Table III, which gives the number of 400-word pages devoted to each type of content in each book, the total number of pages accounted for in each of the texts amounts to more than the actual number of pages in the book.

Because of the overlapping in Table III, vertical totals have not been determined. There is no overlapping among the first eight types of content or among the last five, but a great many of the pages listed under one of the first eight types are also listed under at least one of the last five. Most of the material included in the other three types of content is also listed under other headings in the table. The amounts of overlapping vary considerably between

TABLE III. NUMBER OF 400-WORD PAGES GIVEN TO EACH TYPE OF CONTENT IN ARITHMETIC TEXTBOOKS FROM 1821 TO 1850

Type of Content	Colburn, Warren, *Intellectual Arithmetic*, 1821	Thompson, Zadock, *The Youth's Assistant in Practical Arithmetic*, 1825	Hasel r, F. R., *Elements of Arithmetic*, 1826	Smiley, Thomas T., *The New Federal Calculator*, 1828	Ostrander, Tobias, *The Elements of Numbers*, 1829	Guthrie, Jesse, *The American Schoolmaster's Assistant*, 1834	DeMorgan, Augustus, *The Elements of Arithmetic*, 1835	Talbott, John L., *The Western Practical Arithmetic*, 1841	Adams, Daniel, *Adams' New Arithmetic*, 1848	Chase, Pliny E., *The Common-School Arithmetic*, 1848	Perkins, George R., *An Elementary Arithmetic*, 1849	Davies, Charles, *Arithmetic*, 1849; and *First Lessons in Arithmetic*, 1852	Total
	9	10	11	12	13	14	15	16	17	18	19	20	
Definitions and explanations	4.84	13.31	30.69	5.86	7.87	12.93	12.75	8.92	22.15	12.80	14.22	27.38	173.72
Tables and explanations	13.78	8.52	11.49	12.22	7.92	11.80	8.05	5.26	17.08	10.96	16.60	24.90	148.58
Rules and explanations	2.36	40.29	18.63	20.97	28.15	28.56	29.34	20.44	25.83	21.16	30.29	31.69	297.71
Examples and explanations	11.66	33.94	88.75	14.07	15.68	48.12	53.61	62.02	76.11	38.81	74.07	66.59	583.43
Drill problems without answers	25.40	4.71	10.19	4.69	6.68	2.85	.04	4.99	8.03	45.54	.87	56.35	170.34
Drill problems with answers	1.61	12.63	.93	17.45	21.01	10.17	7.14	20.54	13.96	1.58	19.89	32.72	159.63
Written problems without answers	44.89	3.36	12.58	0	.41	0	0	1.37	10.54	30.10	10.85	49.02	163.12
Written problems with answers	3.98	38.87	7.45	40.64	57.86	49.20	5.32	46.24	65.42	10.34	48.28	53.02	426.62
Reduction	9.88	23.55	20.86	17.90	24.48	26.20	19.64	20.26	34.88	18.39	36.64	66.35	319.03
Combined addition and subtraction	2.24	0	1.86	0	.31	0	.95	0	2.10	1.58	.91	1.86	11.81
Combined multiplication and division	11.42	0	0	0	0	0	0	11.16	4.30	1.85	0	.23	28.96
Combined addition	11.81	13.08	11.39	10.19	10.19	4.03	5.03	8.78	11.56	8.10	12.59	42.22	148.97
Combined subtraction	2.80	7.48	11.44	7.67	6.78	3.34	5.45	7.91	9.62	9.72	9.19	25.05	106.45
Combined multiplication	34.73	9.64	18.73	12.54	11.28	7.13	16.63	9.97	23.89	12.80	12.44	42.47	212.25
Combined division	22.05	9.64	23.44	8.84	9.06	8.36	19.77	14.27	28.03	18.61	18.41	51.13	231.61
Questions	4.29	12.11	0	12.85	4.66	.34	.08	6.27	20.36	5.85	4.95	41.64	113.40

types, some content being classified under at least two headings while other material is not included under any of them. These classifications have been made with entire disregard for interrelations of different types of content.

The longest book, Davies' series, gives more pages than any of the other texts to as many as 10 of the 16 types of content, while the shortest book, *Colburn's Intellectual Arithmetic*, gives more standard pages than any of the others to addition and subtraction combined and to multiplication and division combined. Hassler gives more pages than the others to definitions and examples and their explanations, Thompson to rules and explanations, and Adams to written problems with answers.

One book omits questions altogether, three omit written problems without answers, four omit addition and subtraction combined, and seven omit multiplication and division combined. Smiley and Guthrie leave out the last three of these, but no other book omits more than two of the 16 types of content.

In all 12 books combined, 583.43 standard pages are given to examples and their explanations. This is more than 150 pages more than the space given to any other one type of content. However, written problems are given as much as 589.74 pages when problems with answers and those without answers are combined. It is interesting that approximately the same amount of space is given to explained examples as to written problems set up to give the pupil opportunity for applying his newly acquired knowledge.

Next in number of pages (329.97) is drill problems, when those with and those without answers are combined. Reduction is the only other type of content given more than 300 standard pages of space in all books combined. The only two types given less than 100 pages are addition and subtraction combined (11.81) and multiplication and division combined (28.96), but in both of these cases a large proportion of the books omit the topic altogether.

The relative emphasis given to these various types of content is shown in Table IV in terms of percentage of space given to each by the 12 texts individually and to all books combined.

Examples and their explanations are given almost one fourth of the space in the 12 books combined, nearly 7 per cent more than any other kind of material. The fact that Hassler's *Elements of Arithmetic* gives almost half its space (43.75 per cent) to this type of content and Ostrander gives less than 10 per cent shows there is an unusually wide range in emphasis given the topic by the various texts. Drill problems and written problems, both with and without answers, take up 38.50 per cent of the space, while rules and their explanations take up 12.56 per cent, definitions and their explanations 7.27 per cent, and tables and their explanations 6.22 per cent. As has been stated, none of the material under these headings overlaps.

Of the other eight types of content, reduction is the only one which takes more than 10 per cent of space. There seems to be unusual agreement among the authors of these texts as to the emphasis to be given to reduction, the range being only from 8.31 to 16.23 per cent.

TABLE IV. PER CENT OF 400-WORD PAGES GIVEN TO EACH TYPE OF CONTENT IN ARITHMETIC TEXTBOOKS FROM 1821 TO 1850

Type of Content	Colburn, Warren, *Intellectual Arithmetic*, 1821	Thompson, Zadock, *The Youth's Assistant in Practical Arithmetic*, 1825	Hassler, F. R., *Elements of Arithmetic*, 1826	Smiley, Thomas T., *The New Federal Calculator*, 1828	Ostrander, Tobias, *The Elements of Numbers*, 1829	Guthrie, Jesse, *The American Schoolmaster's Assistant*, 1834	DeMorgan, Augustus, *The Elements of Arithmetic*, 1835	Talbott, John L., *The Western Practical Arithmetic*, 1841	Adams, Daniel, *Adams' New Arithmetic*, 1848	Chase, Pliny E., *The Common-School Arithmetic*, 1848	Perkins, George R., *An Elementary Arithmetic*, 1849	Davies, Charles, *Arithmetic*, 1849; and *First Lessons in Arithmetic*, 1852	Total
	9	10	11	12	13	14	15	16	17	18	19	20	
Definitions and explanations	4.07	7.28	15.13	4.44	4.93	7.80	8.89	4.64	8.18	6.99	6.20	6.70	7.27
Tables and explanations	11.59	4.66	5.66	9.26	4.96	7.12	5.62	2.74	6.30	5.99	7.24	6.09	6.22
Rules and explanations	1.99	22.05	9.18	15.90	17.65	17.24	20.47	10.64	9.53	11.56	13.21	7.75	12.46
Examples and explanations	9.81	18.57	43.75	10.67	9.83	29.04	37.40	32.27	28.09	21.20	32.30	16.29	24.42
Drill problems without answers	21.37	2.58	5.02	3.56	4.19	1.72	.03	2.60	2.96	24.88	.38	13.79	7.13
Drill problems with answers	1.35	6.91	.46	13.23	13.17	6.14	4.98	10.69	5.15	.86	8.67	8.01	6.68
Written problems without answers	37.76	1.84	6.20	0	.26	0	0	.71	3.89	16.44	4.73	11.99	6.83
Written problems with answers	3.35	21.27	3.67	30.81	36.27	29.70	3.71	24.06	24.15	5.65	21.06	12.97	17.86
Reduction	8.31	12.89	10.28	13.57	15.35	15.81	13.70	10.54	12.87	10.05	15.98	16.23	13.35
Combined addition and subtraction	1.88	0	.92	0	.19	0	.66	0	.78	.86	.40	.46	.49
Combined multiplication and division	9.61	0	0	0	0	0	0	5.81	1.59	1.01	0	.06	1.21
Combined addition	9.94	7.16	5.61	7.73	6.39	2.43	3.51	4.57	4.27	4.43	5.49	10.33	6.24
Combined subtraction	2.36	4.09	5.64	5.82	4.25	2.02	3.80	4.12	3.55	5.31	4.01	6.13	4.46
Combined multiplication	29.22	5.27	9.23	9.51	7.07	4.30	11.60	5.19	8.82	6.99	5.43	10.39	8.88
Combined division	18.55	5.27	11.55	6.70	5.68	5.05	13.79	7.43	10.35	10.17	8.03	12.51	9.69
Questions	3.61	6.63	0	9.74	2.92	.21	.06	3.26	7.52	3.20	2.16	10.19	4.75

In dealing with the four fundamental processes, more emphasis is given to addition than to subtraction by all 12 books combined, with multiplication given considerably more space than addition, and division given the most space of all. These four types of content together take 29.27 per cent of the space in the 12 books. Guthrie gives less space to each of these topics than do any of the other books, while Colburn gives more emphasis than the others to both multiplication and division and Davies gives more emphasis than the others to both addition and subtraction.

All but three of the books give subtraction less space than any of the fundamentals, while as many as 11 give the greatest amount of space to either multiplication or division, eight of them emphasizing division more than the others.

Although in many cases the books vary widely in the emphasis they give to different content, there is almost no evidence of trends in the presentation of material. On the whole, it can be said that there is little agreement in the distribution of emphasis within the books analyzed in this period with regard to types of content. As many as 10 books include either examples and their explanations or written problems with answers as one of the two types of content given the greatest amount of emphasis, while 11 books include either addition and subtraction combined or multiplication and division combined as one of the two given the least space. There is rather general agreement about the proportion of emphasis given to tables and their explanations, reduction, all subtraction, and all multiplication. On other topics, however, there is a wide range. For example, as many as six books give very little emphasis to drill problems without answers or to written problems without answers, while Colburn, Chase, and Davies place them either at the top or very close to it.

Analysis of problem subjects.—Another point of view regarding the content of arithmetic texts is that of the relationship of the subjects dealt with to economic and sociological conditions and to other interests of the people. Through an analysis of these problem subjects it is possible to estimate in some degree the practicality of arithmetic textbooks of the period.

In order to obtain a picture of the subjects about which problems were made, the written problems (problems of application) in each book have been analyzed and their subjects noted. A problem might have one or more concrete subjects. For example, if a problem asks the pupil the value of seven tons of hay at $15 per ton, hay is the one concrete subject; on the other hand, if this problem asks for the difference in value between this amount of hay and five mules at $90 each, it includes two concrete subjects, hay and mules. All such problem subjects found in the written problems of each book were arranged in alphabetical lists, and finally grouped and put in table form, showing their frequency of mention in each book. The grouped subject headings were classified as economic, socio-economic, sociological, and miscellaneous. Although these classifications were based on accepted definitions of economics and sociology, it was necessary to rely on personal opinion to determine

under which classification some of the grouped subjects should fall. A few topics which might have nearly equal significance from either the economic or sociological point of view were classed under the joint heading socio-economic, and a few which did not seem to be either sociological or economic in implication were grouped as miscellaneous. Table V, formed from these data, shows in general the nature of the concrete subjects about which the problems were made.

A study of Table V shows that in the 12 books combined there are, exclusive of such general terms as "men," "boys," and "people," 7,764 frequencies of specific subjects about which problems are made. Of these, 1,157 are frequencies of use of miscellaneous subjects and 6,607 have economic or sociological significance, or both. Since there are 589.74 standard pages of written problems in these books, the frequency of mention of economic or sociological subjects is at the average rate of 11.2 per standard page. This average varies with the different books from only 6.2 in Thompson's book to as many as 32.5 in DeMorgan's text. This latter text, however, contains more than twice as many mentions per page as any other book.

Among the major economic subjects, food and farm products predominate. These are used 2,243 times, and make up nearly 30 per cent of all problem subjects used. Cloth and clothing is next in frequency, appearing 983 times and making up about 12.5 per cent of all subjects. Among the other major subjects, occupations are mentioned 518 times; buildings and construction work, 266; transportation, 185; wood and timber, 148; farms, fields, and fencing, 135; household equipment, 122; estates, fortunes, and property, 121; notes, 119; and land (public and private), 108. The remaining subjects are mentioned less than 100 times each, or less than once in each five pages of written problems in all books combined.

The number of economic subjects varies in each book with respect both to specific subjects and to totals. The range of the totals is from 160 in both Hassler's and DeMorgan's book to 1,215 in Davies' texts. This difference is not quite as great as it looks, however, since DeMorgan's book also presents the fewest pages of written problems, Hassler's the next to the fewest, and Davies' the most.

Of the socio-economic subjects, education is mentioned 126 times in all books combined, with a range in the various texts from 0 to 68 times, with more than half of the mentions in all books being found in Davies' series. Military situations and references, and travel are mentioned 111 times each, and in both of these the range is also rather wide. Only 430 socio-economic subjects are mentioned in the 12 books combined. The range (12 to 145) is also wide, with Davies' book including more than three times as many mentions of such subjects as any other book and about one third as many as of all books combined.

Under the sociological grouping alcoholic beverages are used as subjects of problems 308 times. Approximately half of these mentions of alcoholic beverages are to wine. The range in number of mentions of most of the sociological subjects is comparatively small, the only wide difference being in alcoholic beverages, 0 to 59. It is interesting that only one book mentions population and census more

TABLE V. FREQUENCY OF MENTION OF PROBLEM SUBJECTS IN ARITHMETIC TEXTBOOKS FROM 1821 TO 1850

Problem Subjects	Colburn, Warren, *Intellectual Arithmetic*, 1821	Thompson, Zadock, *The Youth's Assistant in Practical Arithmetic*, 1825	Hassler, F. R., *Elements of Arithmetic*, 1826	Smiley, Thomas T., *The New Federal Calculator*, 1828	Ostrander, Tobias, *The Elements of Numbers*, 1829	Guthrie, Jesse, *The American Schoolmaster's Assistant*, 1834	DeMorgan, Augustus, *The Elements of Arithmetic*, 1835	Talbott, John L., *The Western Practical Arithmetic*, 1841	Adams, Daniel, *Adams' New Arithmetic*, 1848	Chase, Pliny E., *The Common-School Arithmetic*, 1848	Perkins, George R., *An Elementary Arithmetic*, 1849	Davies, Charles, *Arithmetic*, 1849; and *First Lessons in Arithmetic*, 1852	Total
	9	10	11	12	13	14	15	16	17	18	19	20	
Economic Subjects													
Bankruptcy	0	1	1	1	0	0	2	1	1	6	0	0	13
Banks and banking	2	0	1	2	1	2	0	3	4	1	1	8	25
Bonds	0	0	0	0	6	6	0	1	0	0	0	1	14
Buildings and construction work	1	6	17	10	13	18	2	60	73	30	18	18	266
Carpeting	0	0	0	1	0	0	0	2	5	3	2	3	16
Cloth and clothing	111	43	13	53	134	4	121	73	122	69	45	195	983
Coal	4	0	0	1	0	0	0	2	5	3	2	3	20
Estates, fortunes, and property	0	6	4	7	6	17	0	3	28	26	5	19	121
Farms, fields, and fencing	4	7	2	6	7	6	2	7	24	23	12	35	135
Foods and farm products	372	103	35	141	113	101	3	201	313	215	116	530	2,243
Goods	0	0	6	4	4	14	2	14	10	2	7	15	78
Household equipment	1	5	4	2	11	6	1	10	19	12	9	42	122
Income and revenue	0	5	10	3	1	7	0	5	4	0	1	11	47

TABLE V—CONTINUED

Indebtedness	1	2	1	1	6	15	1	9	21	15	7	20	99
Land (public and private)	0	2	4	4	11	9	3	8	30	14	6	17	108
Money and coinage	0	5	1	2	10	3	0	5	13	0	9	35	83
Notes	0	10	0	0	7	22	0	3	27	17	7	26	119
Occupations	1	3	30	33	32	37	2	46	101	50	39	144	518
Partnerships in business	5	0	0	0	11	9	1	2	2	8	6	3	47
Prize money and lotteries	0	2	2	0	2	4	0	0	5	0	1	1	17
Rations	13	1	4	0	1	0	0	1	3	10	0	18	51
Rent	0	0	0	3	0	6	0	1	7	3	0	4	24
Stocks	0	0	3	0	1	9	0	0	14	8	0	3	38
Taxes	0	4	1	0	1	2	0	0	9	3	2	3	25
Transportation	5	5	7	5	6	9	10	13	36	23	36	30	185
Walls (brick and stone)	6	0	8	6	4	0	10	24	17	2	11	9	97
Wood and timber	8	7	6	2	18	12	0	21	35	2	15	22	148
Socio-Economic Subjects													
Board bills and lodging	3	2	0	1	1	1	0	1	0	0	1	4	14
Charities	0	0	0	1	0	1	0	4	0	0	0	1	7
Education	0	4	1	0	2	8	0	6	16	7	14	68	126
Military situations and references	1	19	14	4	5	12	5	4	12	5	9	21	111
Travel	1	2	7	8	14	1	1	11	11	10	4	41	111
Wages (salaries)	15	2	7	4	2	0	6	4	4	0	7	10	61
Sociological Subjects													
Beverages (alcoholic)	59	9	7	18	43	35	0	19	58	2	4	54	308
Candles	2	0	1	3	0	0	0	2	2	1	0	2	13
Cisterns	7	4	0	1	7	8	1	5	5	10	1	7	56
Family	4	2	1	0	2	2	0	1	4	6	2	5	29
Medicine	3	0	1	0	1	1	0	1	4	2	0	5	18
Moats and ditches	0	0	0	1	2	2	0	4	3	0	0	1	13
Moral issues	1	0	1	0	1	0	0	0	1	2	0	2	8
Population and census	0	1	1	0	0	1	0	0	1	1	1	19	25
Recreation	3	0	5	3	1	0	0	3	2	3	0	45	65

TABLE V—CONTINUED

Problem Subjects	9	10	11	12	13	14	15	16	17	18	19	20	Total
Miscellaneous Subjects													
Age determination	2	2	0	0	3	3	0	0	7	11	3	17	48
Animals	59	45	27	23	27	35	3	19	62	33	20	164	517
Boards	7	0	3	1	2	1	0	10	9	3	4	5	45
Climate	0	3	2	0	4	0	0	0	5	3	5	2	24
Earth	0	12	2	1	3	3	2	3	12	1	14	12	65
Geographic references	0	3	0	0	5	0	0	0	4	0	2	3	17
Height and shadow of pole, tower, post, etc.	9	2	0	2	4	5	0	1	1	2	0	3	29
History (current and past)	0	2	9	1	4	5	1	1	11	5	3	10	52
Metal articles	1	7	2	2	10	5	0	4	24	5	6	13	79
Metals and alloys	1	7	1	10	18	13	0	7	22	9	11	18	117
Planetary system	0	5	2	0	3	1	0	5	11	1	9	4	41
Political references	0	1	0	0	2	2	0	0	0	1	6	1	13
Time	8	5	1	3	4	2	0	0	8	3	0	5	39
Trees	7	5	0	2	11	5	0	8	9	8	8	8	71
Total economic subjects	534	217	160	287	406	318	160	515	928	545	357	1,215	5,642
Total socio-economic subjects	20	29	29	18	24	23	12	30	43	22	35	145	430
Total sociological subjects	79	16	17	26	57	49	1	35	80	27	8	140	535
Total miscellaneous subjects	94	99	49	45	100	80	6	58	185	85	91	265	1,157
Grand total	727	361	255	376	587	470	179	688	1,236	679	491	1,765	7,764
Number of standard pages of written problems	48.87	42.23	20.03	40.64	58.27	49.20	5.32	47.61	75.96	40.44	59.13	102.04	589.74
Average number of times economic, socio-economic, and sociological subjects are mentioned on each page of written problems	13.0	6.2	10.3	8.1	8.4	7.9	32.5	12.2	13.8	14.7	6.8	14.7	11.2

than once, and this, Davies' text, uses it 19 times. In all, there are only 535 sociological subjects used in these texts, 140 of which are in Davies' book.

Under the miscellaneous group, animals are mentioned 517 times in all books or at an average of nearly once for each page of written problems, and metals and alloys are mentioned 117 times. All books use animals as the subjects of some of their written problems.

In general, the books having the greatest number of pages of written problems also have the most problem subjects. Adams' and Davies' arithmetics, for example, stand first and second, respectively, both in amount of space given to written problems and in number of problem subjects. DeMorgan's text, on the other hand, not only has the fewest pages of written problems but also has the smallest number of problem subjects in each one of the main groups of subjects. Some books, however, are not so consistent.

It seems safe to assume that the fewer the mentions per page of economic or sociological subjects, the less a book is related to practical life situations. Yet the fact that a book mentions such topics frequently does not necessarily insure that the problem subjects used were common during the period in which the texts were written; some of the subjects or even entire problems may have been borrowed from earlier texts.

Detailed subjects.—An analysis of detailed lists of problem subjects, such as lists of occupations, household equipment, and metal articles, and an interpretation of these items in the light of the history of the times gives some idea of the association of arithmetic, as found in these texts, with life as it was lived from 1821 to 1850. Many of the items presented in these lists were not only common 100 years ago, but are still common today; others have dropped out of use. The following is a detailed list of the more unusual measures found in the written problems of the texts analyzed:

bales of:
- broadcloth
- cloth
- goods
- muslin
- sheeting

barrels of:
- beef
- bread
- figs
- fish
- flour
- gin
- molasses
- oil
- pork
- raisins
- salt
- soap
- sugar
- wine

boatloads of wood
brigade of horses
bushels of:
- malt
- salt

butts of wine
casks of:
- alum
- brandy
- molasses
- prunes
- raisins
- sugar
- wine

chaldron of coal
chests of tea
cords of wood
cwt. of:
- cheese
- cocoa
- flour
- passengers
- rice
- sugar
- sugar in boxes
- tobacco

firkin of butter
gills of:
- beer
- brandy
- wine

hogsheads of:
- brandy
- molasses
- rum
- sugar
- tobacco
- water
- wine

ingots of silver
kegs of:
- butter
- lard
- molasses
- raisins
- tobacco

packs of cloth
pea to a steelyard
pint of chestnuts
pipe of wine
pound of candles
renting a horse by the mile
tankards
tierces of salt
wagon loads of:
- corn
- grain

Today we seldom hear scales referred to as a steelyard; malt and salt are not commonly sold by the bushel, coal by the chaldron, or salt by the tierce; barrels are never used as containers of bread and are seldom used for such items as flour; and wood is not commonly transported by the boatload. In our machine age it is not common to rent a horse by the mile or to buy candles by the pound. Bales and packs of cloth are strange terms to most of us. Yet these terms were in common use before 1850, and their inclusion in arithmetics indicates that the problems were of practical significance.

A few of the price quotations found in these early texts are of interest. Some of the following prices listed in these arithmetics are no doubt typical of the period:

arithmetics	from 18¢ to $.375
beef	7½¢ per lb.
butter	from 9¢ to 27¢ per lb.
cheese	from 4½¢ to 18¢ per lb.
coal	$4.625 per ton
coffee	from 11½¢ to 44¢ per lb.
corn	from 25¢ to 75¢ per bu.
flannel	50¢ per yd.
flour	from $5 to $5.625 per bbl.
ham	17½¢ per lb.
hats	from $1.25 to $4.25 each
hay	$10.50 per ton
land	$13.67 per acre
leather	20¢ per lb.
linen	55¢ per yd.
muslin	from 11¢ to 37½¢ per yd.
oats	$.334 per bu.
pencils	5¢ each
pork	5¢ to 7¢ per lb.
potatoes	25¢ to 45¢ per bu.
primers	6¢ each
quills	$1.375 per 1,000
salary of clerk	$95 per mo.
sheeting	10¢ per yd.
shoes	from $1.12½ to $2.25 per pair
silver	72¢ per oz.
spelling books	12¢ each
stockings or hose	from 87½¢ to $1.25 per pair
sugar	from 6½¢ to 12½¢ per lb.
tea	from 62½¢ to $1.75 per lb.
tobacco	from 7½¢ to 9¢ per lb.
wages in woolen factory	$274 per year
wages of labor	from 38¢ to $3 per day
wheat	from 50¢ to $1.25 per bu.

Some of the occupations followed during the period from 1821 to 1850 are also very interesting. Those listed in arithmetic problems were probably common at that time; many are still common today, though a few have either ceased to exist as distinct vocations or are known today by different names. The names of some of the vocations must have been changing at about this period; for example, apothecary and druggist are both mentioned in the books analyzed. Couriers, drovers, and chaise-makers have ceased to exist as a result of improved methods of transportation and communication. The following is a list of those occupations listed that are not common today:

apothecary	glazier	paver
carter	goldsmith	peddler
chair-maker	grazier	privateer
chaise-maker	hatter	shoemaker
cooper	journeyman	silversmith
courier	lieutenant of a ship	teamster
draper	malster	tinker
drover	matcher	trader
factor	mercer	usurer
flour merchant	midshipman	vinter
gate-keeper	miller	

Some of the crafts common in the early half of the nineteenth century have since been absorbed almost entirely by larger industries, but most of the vocations mentioned are still common in some branch of American life. In the 12 books of this period 102 different vocations were mentioned, some of them many times. Thus the written problems should have seemed practical to the children from almost every occupational environment.

Another point of view which may indicate the practical application of written problems to the environments of children is the range of types of cloth and clothing mentioned. Many of these types are still common today and presumably most of them at least were common articles of trade and wear in the second quarter of the nineteenth century. Several of them, however, such as bombazett, humhum, and stuff, are either seldom or never made at the present time, or are produced under a different name. Yet the frequency of these types of cloth as subjects of arithmetic problems indicates that they must have been common articles of dry goods trade near the time at which the books analyzed for this unit were written. The following is a list of the more unusual types of cloth and clothing mentioned in these 12 texts:

alpacca	Holland cloth	sarcenet
baize	hose (worsted and cotton)	satinet
bocking	humhum	serge
bombazett	Leghorn	shalloon
bombazine	lustring or lutestring	Silecia
bonnet ribbon	matting	stuff
boots	merino	twist
brocade	nankeen or nankin	veil
camblet	pantaloons	waistcoat
Canton crape	plush	worsted yarn
cassimere	riband	
durant		

The analysis of the written problems of these 12 texts yielded 79 different topics of cloth and clothing, many of which are mentioned frequently in the written problems. This application of problems to articles of cloth and clothing common at the time must have made the pupils feel that they were not wasting time in their study of arithmetic, but instead were learning to solve the types of problems which many of them might be called upon to solve in actual life situations.

A number of the problems in the texts of the period are based on the sale of alcoholic beverages. Since these books were written before the days of united temperance drives, and alcoholic drinks were

very common items of trade, it is not surprising that such sales were deemed as suitable topics for written problems. If the problems were to be adapted to the social and economic conditions existent at the time, such topics would be as legitimate as any other problem subjects drawn from life situations with which the pupils were acquainted. The entire list of different alcoholic beverages derived by the analysis is as follows:

alcohol	gin	rum	cherry
ale	liquor	whiskey	claret
beer	mead	wine:	Flemish
brandy	porter	canary	Malaga
cider			

Some of the beverages in this list are mentioned quite frequently. Only one of the 12 books omits any reference to such drinks.

Several medicines and drugs are mentioned, though none of them are referred to frequently. The following list is interesting because several medicines mentioned are rarely dispensed directly to the customer by the druggist today except as they may be used in medical compounds or may be prescribed by the physician. It was relatively easy to obtain laudanum and opium at the time these texts were written, but their use has since been definitely restricted. The problems mentioned the following drugs:

alum	emetic tartar	laudanum	salts
aquafortis	epsom salts	opium	sarsaparilla
drugs	jalap	quinine	

Though few in number, the references to medicines and drugs indicate an effort to extend the problem subjects to include a wide range of items with which the general public was well acquainted.

Foods and farm products are mentioned in the texts analyzed for this period more frequently, on the average, than any other type of topic. However, most of the items are still in common use. Probably the only ones that are not well known at the present time are bread loaf, hop, mace, and penny roll.

Foods would be of common interest to all children, and, since America was at that time largely an agricultural nation, it was only logical that problems utilizing problem subjects drawn from agriculture would be of more universal interest than many other types of subjects. Thus the greater frequency of use of these topics indicates that the authors in this respect were approaching the goal of providing practical texts adapted to the needs of pupils. Some of the authors pointed out that this goal was their aim in preparing their materials. Nearly all the foods and farm products mentioned are still common today.

A number of problem subjects in these books are drawn from the animal kingdom. In all the books combined the name of some type of animal is used at the rate of nearly once on each standard page of written problems. Some of the 38 different animals used are domestic and farm animals, while others are not, and all of them, except, perhaps, ass, greyhound, and oxen, are common in rural areas today.

However, a number of them are closely related to economic conditions, especially in rural life. It is significant that a knowledge of these various animals comes within the range of common pupil experiences and that it is often necessary to make mathematical calculations about them. Thus, in the practical application of arithmetic for children who come predominately from rural districts, it is quite fitting that such a considerable portion of the problems use animals as a basis for concrete work. Certainly it indicates that the authors were attempting to adapt their products to life needs and also to arouse interest by this means.

Only a few metals and alloys are used as the subjects of problems in the arithmetics published from 1821 to 1850. This lack of attention to metals is natural, since America was not yet an industrial nation. Industries using metals were small, and in so far as the general public was concerned, metals, with the exception of those used for coin, were used largely in their more nearly crude forms for small tools and utensils. Thus any great amount of use of metals in arithmetic problems would not have been practical nor particularly valuable in providing experiences adapted to the needs of the people. The following is the complete list of metals and alloys included in the written problems of the texts analyzed:

brass	gold	lead	silver
copper	gold dust	mercury	steel
galena (lead ore)	iron	metal	tin
gilding			

Though a few different types of metals are mentioned, several kinds of metal articles are used as problem subjects in this period. These were, no doubt, the chief uses of metals up to 1850 and thus represent another practical application of problems to everyday life. Some of the less common metal articles mentioned which do not seem to be exclusively household articles are as follows:

brass bell	iron bar
horseshoe	iron screw
horseshoe nail	musket
iron ball	silver can

Several of the items of household equipment mentioned as the subjects of concrete problems are also definitely made of metal while others are not:

brass kettle	earthen ware	pincushion	sofa
churn	gold cup	silver porringer	tin pan
cook-stove	matting	silver tankard	

Several of the items in this list give a general idea of the furnishings of homes in early days. Such items as churn, brass kettle, and matting were, as may be recalled, common before 1850 but these are no longer found in the majority of homes today. Most of the items mentioned, however, were undoubtedly within the range of the experiences of the majority of pupils and thus indicate an attempt on the part of the authors of the texts to present problems of practical significance.

Likewise, the numerous references made to buildings and construction work give some definite information regarding the nature of construction work during the period in which these 12 books were written. Most of the items concern facts about which nearly all pupils would find it necessary to make mathematical calculations at some time during their lives, and many of them are still of practical significance today. All of the items, except possibly slate roof, are common today.

Some other items used as the subjects of written problems which reflect some definite characteristics of the age are those dealing with aspects of education. Most of these terms, also, are in common use today, but a few of the more unusual items include academy, bench in a schoolroom, ciphering, copy book, inkstand, scholar, and slate.

The academy, as an institution, was prospering about this time. Slates and benches in a schoolroom have disappeared even in remote rural schools, and ciphering and scholars are terms seldom used in public education today.

The items pertaining to transportation and travel mentioned in the various texts show that stage routes, canals, and natural inland waterways were still widely used in this era. The problem subjects, which include nearly all of the means of travel by land and by water at the time, deal with costs, time, rate, and loads carried. The more unusual terms relating to transportation and travel are:

chaise	post-road	sleigh	toll bridge
cribs on a raft	rigging of a vessel	sloop	towing path (canal)
foot-path		stage route	
gig			

References to military items appear about once in every five standard pages of written problems in the 12 books. Since the War of 1812 took place only a few years earlier and the war with Mexico was fought during the period of this study it is not surprising that military situations and instruments of war were of interest at the time. The fact that the frontier was moving westward and that it was necessary to maintain garrisons near the western outposts of civilization and along routes of travel through the yet unsettled territory added to the interest in war topics. Most of the terms used are very common today, such as ammunition, fort, and general; but there are a few uncommon terms used, such as cannon shot, horse brigade, and rifleman.

A few references are made to items pertaining to government, but these are not as numerous as might be expected in these years so close to the organization of the country as a democratic nation. Thus, it seems that the correlation of arithmetic with processes of government was neglected.

Such subjects as chessboard, dice, kite, marble, and top indicate the recreational topics used. Relatively few of these items are found.

A few references to items related to climate and weather and to other geographic subjects are also included. These geographic terms include names of cities, states, and countries, mountains, volcanoes, islands, etc., and deal with areas, population, and distances.

Several references are made to items of historical interest. Most

of these are found in problems dealing with differences in dates or time or with the size of armies. Those mentioned are:

Archimedes
Battle of Bunker Hill
Battle of Lexington
Benjamin Franklin
Bonaparte's Army
Burgoyne and his army
Columbus
Cornwallis
Declaration of Independence
Discovery of America
General Peace of Europe (1666)
General Peace of Europe (1815)
George Washington, First President
Henry I's reign
Henry Hudson
Hiero (King)
Isaac Newton
Massacre at Boston
Pliny
Pyramids of Egypt
Revolutionary War
Surrender of Yorktown
Washington (dates related to)
William II's Reign
Xerxes' Invasion of Greece

A few references are drawn from the history of literature. The frequency of mention of these subjects, however, is so small as to be almost insignificant.

Certain types of these problem topics or situations are found frequently in nearly all books, but, while the topics themselves are practical, the problems frequently use entirely impractical quantities. The following are typical of what may be called "common type" problems used frequently in the books analyzed:

arranging army in "square battalion"
borrowing money
building a wall
buying cloth for tailoring
buying livestock, etc.
carpeting a floor
carrying fruit in a basket
determining length of shadows of poles
determining relative ages of members of family, relative cost of a piece of work, relative time for doing a piece of work by one or more men, relative time for travel at different speeds or by different means, and relative wages
determining time between historical dates—between one and another or from that time to the present
determining time for sound to travel
digging a cellar, cistern, ditch, drain, or trench
dividing a fortune or estate
driving sheep, cattle, hogs, etc.
failing in business
filling or emptying a vessel or cistern by pipes, cocks, or faucets
providing for an army or group of men
purchasing stock at a premium or jointly
reaping grain or mowing grass
settling with his creditors

There are also a number of problem subjects in these books which do not occur very often, though most of them may have been within the range of common knowledge of the people in those days. The more unusual of these subjects include references to such things as:

age of the world
beaver hat
bench in a schoolroom
bird or squirrel in a cage
bung of a cask
chairs bought for the parlor
charity school
cost of hewing timber
course of shingles on a roof
ditch around a castle
hammer of a clock
horse and chaise
mahogany boards
pins in a cushion
public lands sold by the United States
raft of hewn timber
rammer of piles
school of three departments
sheets of paper in a copy-book
sloop employed in carrying bricks
sperm candles
stick of timber
stone pavement
threads of a screw
travel by mail coach
Uranus and other celestial bodies
wall of town surrounded by a moat
weight of lead on a roof

The range of problem situations used is quite broad, and the subjects are drawn from nearly all types of activities then known by the American people, so that most of the problem situations were of practical significance in the daily lives of those living in the fore part of the nineteenth century.

Further relations of the problems found in these early arithmetics to the life of the day may be shown by classified lists of terms, phrases, clauses, and complete problems involving economic and sociological conditions. The following classified references are typical of those dealing with dress, food, human relations, living conditions, morals, national progress, recreation, social customs, and thrift:

Dress—

Having in mind to buy a new suit of clothes, I went to the tailors, ...
Suits lined with Holland
Beaver hat

Foods and beverages—

If a stock of provisions last 5 men 3 weeks, ...
The provisions of a garrison
If a family of 10 persons use 3 bu. of malt in a month . . . .
Bought a chest of tea
What cost a box of sugar?
Bought raisins

Human relations—

Gave money to beggar
A borrowed of B
Men hold joint stocks in a business
Each man's share of a prize taken at sea
A charity school
Buying goods on credit

Living conditions—

A farmer bought a chaise, horse, and saddle
If 2 quarts and one pint of oil be sufficient for 8 lights 4 evenings . . . .
Travel by mail coach
Lady bought 24 chairs for her parlor

Morals—

A man uses tobacco at an expense of $5 a year from the age of 18 till the age of 79 . . . .

In a contribution A puts in £7 14s. 6d.; B puts in £1 8s. 9d.; . . . D drunkard could not spare but 6d. 2 grs.; . . .
A thief is escaping from an officer . . .
A thief, travelling at the rate of 6 miles an hour . . . .
A spendthrift, after squandering his fortune . . . .
Memorizing or reading verses of the Bible
Man at play loses money

National progress—

What must I pay for 27 shares of the Boston and Worcester Rail Road, ...
Time required for message to be transmitted by magnetic telegraph
How much must be paid for constructing 18 miles of plank road, ...
Cost of building railroad
Number of yards of earth necessary to build Erie canal towing path
A certain school . . . is supported on the polls of the scholars and the quarterly expense of the whole school is $75; . . . .

Recreation—

The ticket was so lucky as to draw a prize of 1,000 dollars . . . .
How many different hands may a person hold at a game of whist?
Three men spent $9.40 at a tavern
Men met at inn and grew merry drinking brandy, wine, gin, and cherry
A kite is lodged in the top of a tree

Social customs—

Value of watch and seal
Sons receive more inheritance than daughters

Thrift—

A laboring female was able to put $30 at the end of each year in the savings bank, ...

Travel—

A man being asked his age answered that he left England when he was 12 years old, and that he had afterwards spent 5 years in Holland, 17 years in Germany, 9 years in France, whence he sailed for the United States, ...
Rate of travel by railroad, mail coach, steamboat, or foot

The following classified economic references are typical of those dealing with economics of the home, farm economics, insurance, population, transportation, business transactions, and craft, industry, and occupation.

Economics of the home—

Cost of matting for the floor
How many yards of carpeting . . . will cover a room . . .
Cost of soap
Cost of candles
Cost of stoves and stove pipes

Farm economics—

Amount of hay needed to feed horse through the winter
How much milk a cow will give in year
Average production of wheat per acre
Cost prices of oxen, horses, cows
Cost of potash

How many trees may be planted in orchard
Time required for reaping
Weight of hogs killed
Production of potatoes per acre
Average production of apple trees
Cost of hay

Government economics—

Duties on imports
Raising of revenues
Value of coins produced at mint in 1846
Building of post offices
Costs of transporting mail
Salary of the President of the United States
Cost of Erie canal
Cost of schools in New York state

Insurance—

Cost for insuring farm house
Life insurance company insures at a premium of 1 1/20 per cent
Rate of insurance of a ship's cargo
Insurance on house and furniture at the rate of ⅝ of 1 per cent per year

Population—

Population of the United States in 1840
Population of New York, Maine, and other states
How much white population exceeded the black in 1840

Transportation—

A, B, and C freight a ship with 108 tons of wine, ... but by reason of stormy weather, they were obliged to cast 45 tons overboard . . . .
Bought a quantity of goods at New York . . . .; paid for carting to the dock, 12s. 8d.; paid for freighting the same to Albany, £2 17s. 8d.; then paid for carting the same to Geneva, £7 1s. 10d. . . . .
Shipped mules to West Indies but was obliged to throw some overboard because of storm
Rent a horse by the mile
Hiring coach for travel

Business transactions—

Sold part of a medicinal mixture
Flour speculator bought wheat
Druggist sold bottles of sarsaparilla
Purchased goods at confectioners
Inheritance and wills of estates
A broker is directed to buy 150 shares of the New York and Erie railroad stock
Stockholder receives dividend from Tonawanda Railroad Company
Person bought flour of merchants
Merchant settles with creditors
A barters cheese with B for broadcloth
Division of property
Buying and selling farm
A vinter bought wine
Selling United States Bank stock at 9¼ per cent below par
Taxes assessed by state, county, and city
Incomes of bishop and of minister
Purchasing stock at a premium

Craft, industry, and occupation—

A journeyman charged $19.74 for making 21 pairs of boots
Three carters were hired
Men build a road
Men digging a canal
A peddler sold hats at stores
A laborer hired himself to a farmer
Hewing timbers
Men reap a field
A goldsmith sold a tankard
A grocer mixes teas
A chaisemaker gives directions for building a chaise
A schoolmaster has 62 boys . . .
A privateer takes a prize
Tinker engaged to make kettle
Farmer drives cattle to market
A gatekeeper is to receive 6 cts. for every wagon, 2 cts. for every horseman . . . that passes the gate . . . .
A compositor . . . set up at the rate of 7000 M's per day
A person engages to build stone fences

The preceding lists give a rather detailed picture of the range and types of concrete topics found in the written problems of the books analyzed for this period, 1821 to 1850. It seems evident that the authors utilized the life experiences of the day in forming problems of application.

Unusual problems.—While an author might use a problem subject with which everyone was thoroughly acquainted, he could yet make a very impractical problem, and many of the authors did this with some of their problems. Therefore, in addition to listing problems under such headings as economic, sociological, and historical classifications are also made with respect to whether they are practical, impractical, or puzzle problems.

A problem may be considered as practical for public school pupils not only if it is based on common life experiences about which a large number of people will need to make mathematical calculations but also if it states clearly a problematic situation which rather closely approximates in nature and size the problems which need to be solved more or less frequently by the average layman. Any problem which does not meet these specifications may be termed as impractical. Problems which are stated, intentionally or unintentionally, in such a manner as to be confusing to the pupil by including irrelevant data or presenting data in confused order may be considered as puzzles.

Some of the more practical problems found in the 12 books include:

When 72 bushels of corn cost $56 25 cts., what is the price per bushel?

A certain school, consisting of 60 scholars, is supported on the polls of the scholars, and the quarterly expense of the whole school is $75; what is that on the scholar, and what does A pay per quarter, who has 3 scholars?

A farmer bought a chaise for $210, a horse for $70 and a saddle for $9; what was the whole amount?

The par value of United States Bank stock was $100 per share.

How much was received for 31 shares, at 9¼ per cent below par?

How many yards of carpeting, 3 quarters of a yard wide, will cover a room 18 feet wide and 30 feet long?

What must be paid for insuring $800 on a farm house, at ¼ per cent?

A flour speculator bought wheat at $1.20 per bu., which he was obliged to sell for 95 cts. a bu. What per cent did he lose?

A few typical impractical problems found in these books are as follows:

If a steamboat of 242 feet in length moves 15 mi. an hour, how many times its own length will it move in 11 hours?

How much will 3 loads of hay come to at 3 cents a pound, each load weighing 18 cwt. 3 gr. 24 lbs.?

How many minutes from the commencement of the war between America and England, April 19th, 1775, to the settlement of a general peace, which took place Jan. 20th, 1783?

From the creation of the world, 4004 years before Christ, to the year eighteen hundred, inclusive, how many days have passed?

How many minutes since the birth of Christ, to Christmas 1800, allowing 365¼ days to the year?

If a carriage wheel turn round 346 times in running 1 mile, how many times will it turn round in the distance from New York to Philadelphia, it being 95 miles?

The ages of A, B, and C amount to 133 years: B is 1/5 older than C and A is ⅓ older than B: what are their separate ages?

Required the earth's circumference in inches?

What sum would purchase a horse with four shoes, and 8 nails in each shoe, at 1 mill for the first nail, 2 for the second, 4 for the third, etc., doubling to the last?

As mentioned before, only a very few of the problems found in the texts of this period may be classified as puzzle problems—problems containing irrelevant data or stated in such a manner as to be definitely confusing. The following are examples of such problems:

A man married at the age of 23; he lived with his wife 14 years; she then died leaving him a daughter 12 years of age; 8 yrs. after, the daughter was married to a man 5 yrs. older than herself, who was 40 years of age when the father died; how old was the father at his death?

If four yards of cloth be worth 9 yards of drugget, and 6 yards of drugget worth 13 yards of muslin: how many yards of muslin are worth 120 yards of cloth?

A schoolmaster being asked how many scholars he had, answered, if to double the number, I add ½, ⅓, and ¼ of them, I shall have 333: how many had he?

As I was travelling on the forest grounds,
Up starts a hare before my two greyhounds:
The dogs being light on foot they fairly run
Unto her 16 chains just 21.
The distance she started up before
Was fourscore 16 chains just, and no more
Now, I'd have you unto me declare
How far they run before they caught the hare?

If a fourth of your money you give unto me,
Said A with a smile, to B and to C
With a thousand bright dollars I then should be bless'd
'Twould pay off my debt and set me at rest;
Said B to A, C, I plainly behold
If a fifth of your cash in my pocket were told,
The same sum of dollars my pocket would grace,
And a satisfied smile enliven my face;
If a sixth of your sums were added to mine,
Said C to B, A, I would not repine,
For the same sum of dollars I then would behold,
Each time I approached my purse to unfold.
Ye lads who with learning and genius are bless'd,
Tell the number of dollars each man did possess—
With a heart full of friendship I'll give you my hand,
And say that Position you will understand.

A man driving his geese to market, was met by another, who said, Good morrow, Master, with your hundred geese; says he, I have not a hundred; but if I had half as many more as I now have, and two geese and a half, I should have a hundred; how many had he?

The yearly interest of Charlotte's money at 6 per cent exceeds 1/20 of the principal by 100 dollars, and she does not mean to marry any man who is not scholar enough to tell her fortune; pray what is it?

Most of the practical, impractical, and puzzle problems have either economic or sociological implications, or both. Some problems deal, however, with subject matter which cannot generally be classified under economic or sociological headings. Some of this latter group deal with historical data, and include such problems as the following:

Washington was born in the year of our Lord 1732; he was 67 yrs. old, when he died; in what year did he die?

The invasion of Greece by Xerxes took place 481 years before Christ; how long is that this current year?

Rome being built 817 years after the Pyramids of Egypt, and 146 years before the Christian Era, America having been discovered in 1594 [*sic*], the Declaration of Independence by the United States having taken place 182 years afterwards, and the year of it now counted being 52; how long is it since the building of the Egyptian Pyramids?

In the statements of the problems in some books there are a few unusual expressions of the day, as for example, "I demand to know, what is the answer," which no doubt reflects the rigid discipline still prevalent in many schools at that time. Some other occasional expressions of interest are "scuds away" for runs away; "fireballs" for meteors; "glazing of a house" for window glass; "span of horses" for team of horses; and "fortune" for estate. Such unusual terms were found much less frequently in the books published during this period than they were in books published during the first period of this analysis—1790 to 1820.

Except in a few problems apparently borrowed from early texts, there is almost no attempt to introduce poetry in these texts. Only a few texts use any problems set forth in rhyme and these are usually found among the miscellaneous written problems.

As has been pointed out, most of the authors of this period attempted to produce texts which would meet the needs of individuals in everyday life. The philosophies and methods of presentation in these arithmetics differ; some authors have specified their aim as being to promote mathematical understanding and reasoning while others have emphasized methods of solving specific types of problems mechanically. However most of the problems set for the pupils to solve deal with such economic aspects as buying, selling, and other types of mathematical calculations often needed in the home, on the farm, in business and industry, in the professions, and in such matters as insurance, population, and transportation, or with such sociological aspects as dress, food, human relations, living conditions, morals, national progress, recreation, and social customs. Several problems deal with such factors as ages, history (especially historical dates and differences in the times of their occurrence), time, the planetary system, and animals.

The chief impracticality in the problems is that the sizes of the numbers are frequently much larger than the sizes which would be met in everyday life. A second phase of impracticality is the introduction of problems and principles which the average layman seldom if ever needs. Very rarely does the average person have any direct need for solving problems related to such topics as the planetary system, duties on imports and exports, coinage of money, commission and brokerage, evolution beyond square root, tare, trett, cloff, progression, and logarithms. Another aspect of impracticality entering several of these texts is an overemphasis on common fractions, many fractions being used which are never found in life situations.

The few puzzle problems found in the books are usually presented in the lists of miscellaneous problems at the ends of the books. Thus, though there are impractical problems and aspects of problems in the various books of this period, the practical dominates. This is in keeping with the aims stated or implied by most of the authors of the books analyzed.

SUMMARY AND GENERAL CONCLUSIONS

The analysis of arithmetic textbooks published from 1821 to 1850 has shown some interesting facts relative to the preparation of such texts at that time. It also gives information regarding the practices of teaching then in vogue. Some conclusions that may be drawn are:

1. Most of the texts are bound in board with leather back. The printed pages vary in size, averaging approximately 3 by 5½ inches. The type also varies considerably in size, but on the average it is somewhat smaller than that found in texts written for similar grade levels today. The paper in most of the books is of good quality and the spacing of letters and lines is sufficiently even to make reading relatively easy.

2. Colburn's book, which was the first book published in the group analyzed for this period, is reputed to be the first arithmetic to introduce the inductive approach or method of teaching. Colburn uses this approach entirely; some of the other authors, influenced

by Colburn, use it to a considerable degree, while still others attempt to combine the inductive and the deductive methods. Nearly half the books cling almost entirely to the older deductive approach.

3. Davies' *Arithmetic* and *First Lessons in Arithmetic* are combined and treated as one text in this study, since the material covered by the two books is approximately equivalent to that covered by each of the other texts.

4. Of the 12 books analyzed, the shortest is only 118.87 standard 400-word pages in length, and seems to have been prepared for beginners up to and including the intermediate grades. The range in number of standard pages in the remaining 11 books is from 131.90 to 408.70.

5. There is a wide variation in the texts with respect to both the range of topics treated and the amounts of space given to each. As a general rule, the longer books give more space to each topic and contain more topics than the shorter books. Colburn deals with 9 topics, while no other book includes fewer than 20 topics and Adams' contains as many as 32.

6. Arithmetic symbols, total numeration, total fundamental processes as applied to whole numbers, total vulgar (common) fractions, measures (tables and their uses), and total percentage are common to all texts.

7. In all books combined, the greatest total amount of space (nearly one fifth of the grand total) is given to fundamental processes as applied to whole numbers. The next topics in descending order of total amounts of space given to them are common fractions, compound denominate numbers, percentage, proportion, and powers and roots. Each of the other topics found in the books was given less than 5 per cent of the total space.

8. Few trends are evident. Barter, position or rule of false, and algebra disappear as topics from books published after 1841, and longitude and time, imports and exports, banking, taxes, and analysis, as separate specific topics, enter about that time. A few topics seem to gain in popularity during the period from 1821 to 1850 and a few seem to lose, but these trends are so slight as to be almost negligible.

9. There is little agreement on the distribution of emphasis within the books of the period with regard either to divisional topics or to types of content.

10. In all books combined 13.81 per cent of the space is devoted to drill problems and 24.69 per cent to written problems. Thus a grand total of 38.50 per cent of all space is given to problems for pupils to solve. A total of 24.42 per cent is devoted to examples and their explanations; 12.46 per cent to rules and their explanations; 7.27 per cent to definitions and their explanations; and 6.22 per cent to tables and their explanations.

11. In the treatment of the four fundamental processes as applied separately, 9.69 per cent of the total space in all books is devoted to division, 8.88 per cent to multiplication, 6.24 per cent to addition, and 4.46 per cent to subtraction.

12. Most of the books contain problems both with and without the answers given. About three fifths of the problems are accompanied by the answers. Only one book has its answer key on the last few pages. Three books have no written problems without answers accompanying them.

13. A few of the books emphasize mathematical reasoning as their chief objective. However, understanding of the principles as an outgrowth of logical thinking, whether deductive or inductive, is given the greatest attention. Books which emphasize understanding of principles generally contain fewer problems to be solved and a greater amount of explanatory material than the other texts.

14. Books using the inductive approach usually begin the study of a new process through simple, easy mental exercises which lead up to a statement of the principles and rules. Colburn, though he includes explanations of principles and rules, expects the pupil to form his own concise statements of them. Most other authors employing the inductive approach finally present concise statements of the principles and rules involved and then conclude the study of the process by the deductive method.

15. Authors using the deductive approach entirely present each new process in the following general order: definitions and their explanation, rule and its explanation, example with explanation, drill problems, and written problems. Their books usually are subdivided into minor detailed processes and the emphasis is on the "how to do" each process according to rule rather than on the "why." Emphasis is on the memorization of rules rather than on a mathematical understanding which might enable the pupil to work out a procedure for himself when confronted by a new problem situation.

16. Several of the authors have experimented with varying arrangements of the materials treated. They have attempted to arrange the topics presented either in a natural order of sequence as they have conceived it or in the order of importance in daily life. Thus, though all books start with numeration and the fundamental processes as applied to whole numbers, the order of the remaining topics varies considerably. For example, federal money may be considered along with whole numbers, or included near or with decimals; compound denominate numbers may immediately follow whole numbers or come later in the book; and common fractions may come either before or after decimals.

17. In all books combined, economic, socio-economic, and sociological subjects are mentioned on the average of 11.2 times on each standard page of written problems, the range being from 6.2 to 16.8 times in the various books.

18. Out of a grand total of 7,764 items mentioned as subjects of written problems, 5,642 have economic significance; 430, socio-economic; 535, sociological; and 1,157, miscellaneous.

19. Among the economic problem subjects, foods and farm products predominate, with a frequency of 2,243, or approximately two sevenths of all problem subjects. The next few economic subjects, in descending order of frequency of mention, are cloth and clothing, occupations, and buildings and construction work, with no other type

of economic subjects being mentioned more than 200 times. Of the socio-economic problem subjects, education, military references, and travel are all three mentioned more than 100 times. Beverages is far the most frequent of the sociological problem subjects, being mentioned 308 times while no other major subject is mentioned more than 65 times. Of the miscellaneous problem subjects, animals are mentioned 517 times and metals and alloys 117 times.

20. A few now obsolete or unusual terms are found in the books, such as "I demand to know" for how much, "scuds away" for runs away, and "fireballs" for meteors.

21. A few problem subjects deal with materials, occupations, or customs that are now obsolete, but most of the subjects are things with which the people at this early period were quite familiar. Thus the written problems reveal much about the living conditions, business, and moral standards characteristic of the period.

22. Prices of commodities, as mentioned in written problems of the texts, vary considerably, but with few exceptions vary little from prices today.

23. Problems in some of the books, especially in those employing the inductive approach, have been stated in such a manner as to arouse child interest.

24. Most problems may be considered to be practical both as to subjects and to nature. Impracticality enters in some of the problems, not so much as to subject, but in the size of whole numbers or fractions used. A few problems deal with impractical situations or with types of mathematical calculations not generally required of most individuals in actual life situations.

25. There are very few puzzle problems in the texts analyzed for this period and these are usually found in the miscellaneous problems at the ends of the texts.

THIRD PERIOD—1851 TO 1880

GENERAL DESCRIPTION OF THE TEXTBOOKS USED

THE various books analyzed for the third unit of the study vary somewhat in aims, purposes, underlying psychological theory, and methods of presentation, as well as in format. A careful survey of introductions, prefaces, notes to teachers, and general order of content also shows the major similarities of the books; that is, the features which may be considered as characteristic of those arithmetics published during the period.

Nineteen books were available for the third section of this project. However, in the tabulations in this study these are considered as 16 books because in three cases there are two books in a series. Since in each series one book is designed for beginners and one for more advanced pupils, the two books together cover approximately the same material as is treated by the texts designed for all elementary grades. They are as follows:

21. Dodd, James B. *Elementary and Practical Arithmetic* (new and improved edition). Pratt, Oakley and Co., New York, 1854.
22. Eaton, James S. *The Common School Arithmetic; Combining Analysis and Synthesis; Adapted to the Best Mode of Instruction in the Elements of Written Arithmetic.* Taggard and Thompson, Boston, 1862.
23. Colenso, The Right Rev. J. W., D.D. *Arithmetic, Designed for the Use of Schools: To Which is Added a Chapter on Decimal Coinage* (revised edition). Longmans, Green, and Co., London, 1864.
24. Felter, S. A. *The Analysis of Written Arithmetic* (second edition). Charles Scribner and Co., New York, 1864.
25. Dean, Philotus. *The Intermediate Arithmetic, Containing all the Matter Usually Presented in a Practical Arithmetic, so Simplified as to Adapt It to Beginners; with the Most Approved Models and Analyses. For Public Schools and Academies.* A. H. English and Co., Pittsburgh, 1865.
26. Greenleaf, Benjamin. *Introduction to the National Arithmetic, on the Inductive System, combining the Analytic and Synthetic Methods; in which the principles of the science are fully explained and illustrated.* Robert S. Davis and Co., Boston, 1867.
27. Peabody, Selim H. *Felter's New Practical Arithmetic, for Public and Private Schools.* Charles Scribner's Sons, New York, 1872.
28. Peck, William G. *Complete Arithmetic, Theoretical and Practical.* A. S. Barnes and Co., New York, 1874.
29. French, John H. *First Lessons in Numbers, in the Natural Order: First, Visible Objects; Second, Concrete Objects; Third, Abstract Numbers.* Harper and Brothers, New York, 1874.
Common School Arithmetic; Combining the Elements of the Sci-

ence with their Practical Applications to Business. Harper and Brothers, New York, 1875.

30. Hagar, D. B. *A Common School Arithmetic.* Cowperthwait and Co., Philadelphia, 1877.
31. Mecutchen, S., and Sayre, G. M. *The New American Arithmetic, Part I.* E. H. Butler and Co., Philadelphia, 1877.
    The New American Practical Arithmetic. J. H. Butler and Co., Philadelphia, 1877.
32. Milne, William J. *The Practical Arithmetic on the Inductive Plan, including Oral and Written Exercises.* Jones Brothers and Co., Chicago, 1877.
33. Raub, Albert N. *The Complete Arithmetic, Combining Oral and Written Exercises in a Natural and Logical System of Instruction.* Porter and Coates, Philadelphia, 1877.
34. Ray, Joseph. *Ray's New Practical Arithmetic.* Van Antwerp, Bragg and Co., New York, 1877.
    Ray's Elementary Arithmetic, Embracing Mental and Written Exercises. Van Antwerp, Bragg and Co., New York, 1879.
35. Baker, Andrew H. *Elementary Arithmetic; or, Second Book of a Series of Mathematics.* P. O'Shea, New York, 1878.
36. Olney, Edward. *A Practical Arithmetic for Intermediate, Grammar, and Common Schools.* Sheldon and Co., New York, 1879.

The introduction and preface have been deleted from the copy of Dodd's *Elementary and Practical Arithmetic* which was available for this study; hence it is impossible to make positive detailed statements regarding the author's aims or the pedagogical theory to which he subscribed. From the description on the back of the book it is evident that the author purported to present the principles and also the applications of arithmetic to science. With regard to the arrangement of content, Dodd presents numeration first and then the fundamental processes as applied to whole numbers. These are followed in order by common measures and multiples, reduction and the fundamental processes as applied to common fractions, decimals, weights and measures, monomials and polynomials (known in most books as compound denominate numbers), duodecimals, aliquot parts, ratio and proportion, partitive proportion, percentage, interest, equation of payments, powers and roots, and mensuration. In the appendix Dodd presents geometrical definitions and practical mensuration.

There are 286 numbered pages in this copy of Dodd's book; however, it is quite possible that one or two of the last pages have been deleted. Each page measures approximately 3 ¼ by 5⅝ inches and each full page contains the equivalent of approximately 323 six-letter words. The type is moderately small, but is sufficiently well spaced to make reading relatively easy. The paper seems to be of good quality. The back is of green colored board with black leather binding.

In the preface of his *The Common School Arithmetic,* James S. Eaton states that he has attempted to prepare a text suitable to the needs of the "large class of pupils whose limited time renders it im-

possible for them to pursue an extended mathematical course." Thus he has given more emphasis to "the simple, elementary, practical principles of the science" than to "the more intricate and less practical parts." He further states that in this book "constant attention has been paid to the brevity, simplicity, perspicuity, and accuracy of expression; and no effort has been spared in the endeavor to render the mechanical execution appropriate and attractive."

The author further points out that:

> Definitions, tables, and explanations of signs have been distributed through the book where their aid is needed, to enable the pupil to learn them more readily than when they are presented collectively.
>
> . . . . . .
>
> Brief, suggestive questions have been placed at the bottom of the page, designed in no way to interfere with the free, original questioning which every *teacher* will adopt for himself, but merely to aid the young and inexperienced pupil in fixing his attention upon the more important parts of the subject.

Eaton also insists that the pupils and teacher should not neglect the discipline which comes from proving the operations.

The copy of the book used for this analysis is in good condition. It has a grey board back with black leather binding. The paper is of good quality and the type, though moderately small, is well spaced. There are 312 numbered pages in the book, and each page contains approximately 3½ by 5⅝ inches of printed matter. The average full page contains about 390 six-letter words.

Colenso's *Arithmetic* contains on the back of the title page a paragraph from Dr. Whewell's work on "A Liberal Education," pages 158-9:

> As a basis of all real progress in Mathematics, boys ought to acquire a good knowledge of Arithmetic and a habit of performing the common operations of Arithmetic, and of applying the rules in a correct and intelligent manner. This acquirement appears to be often neglected at our most eminent classical schools. Such a neglect is much to be regretted; for the want of this acquirement is a great practical misfortune, and is often severely felt in afterlife. Many persons who are supposed to have received the best education which the country affords, are, in all matters of numerical calculation, ignorant and helpless, in a manner which places them, in this respect, far below the members of the middle class, educated as they usually are. Arithmetic is a matter of habit, and can be learnt only by long-continued practice. *For some years of boyhood there ought to be a daily appropriation of time to this object.*

The foregoing quotation seems to suffice for an introduction to the book and apparently indicates the purposes which Colenso had in mind while preparing the text.

The organization of the content in Colenso's text is somewhat different from that of most other texts of the period. Approximately the first half of the book is devoted to elementary arithmetic as applied to whole numbers, compound arithmetic, greatest common measure and least common multiple, vulgar fractions, decimal fractions, practice, and proportion. Approximately the next one eighth of the

book is devoted to miscellaneous items of interest, discount, insurance, stocks, profit and loss, and proportional parts. These are followed by an appendix containing standards of money, weight, space and time, and decimal coinage. Approximately the last 40 pages are given to notes and examination papers. The division entitled "Notes" consists of additional examples and explanations of processes not previously presented, that is, different ways of solving types of problems already presented. The "Examination Papers" are largely additional problems to be solved, though this division also contains some examples and explanations.

The copy of Colenso's text which was available for this analysis has a light brown board back with a dark brown oilcloth binding. The paper is of good quality, and the book on the whole is in fair condition. Most of the general explanations, definitions, and rules are in moderate sized, well-spaced type. Examples and their explanations and problems are set in extremely small type, and these constitute most of the book. Exclusive of the answer key, which is given at the end, the book has 193 numbered pages. Each full page contains approximately 459 six-letter words.

The following statement from the preface of Felter's *The Analysis of Written Arithmetic* indicates concise goals which the author had in mind in preparing his book:

> In the Preparation of this work the author has labored to secure, 1st, *discipline of mind* by requiring a *formula* for each step of the analysis; 2nd, *rapidity, accuracy, and complete familiarity with commercial transactions*, by giving a large number of abstract and practical examples and problems; 3rd, *thoroughness*, by a systematic daily review.

It is also pointed out in the preface that, with the introduction of mental arithmetic in the schools at that time, the solution of problems by rule had given place to some extent to analysis, but that the latter had not been applied to the more advanced phases of commercial arithmetic. Recognizing the importance of analysis, Felter has given greater emphasis to it. He has also attempted to present the content in a natural rather than a logical order. He aims at simplicity and avoids "involving the pupil in difficulties before his mind is sufficiently developed to master them." He believes that less attention than formerly should be given to proportion, since "all commercial questions can be more easily solved by analysis." He also feels that reduction of currencies, duodecimals, permutation, and progressions should be presented in higher arithmetic only. Since he was interested largely in the applications of arithmetic to business transactions, he has omitted those topics which he felt were superfluous to commercial arithmetic.

This book by Felter is the second book of a series. The first 75 pages are largely a review of the first book, and the rest of the book is really the continuation of the introductory book. The introductory book, however, was not available for this study.

The author emphasizes the importance of having the pupils ana-

lyze problems by pointing out the more significant elementary questions and the formulas involved. "By this means, he will become self-reliant, unaccustomed to flee for refuge in every difficulty to some *rule;* but will depend upon the exercise of his reason for a solution."

In an attempt to carry out a natural simple order of content, the author has treated United States money and denominate numbers before fractions. A major reason for this arrangement, he says, is that "after the scholar has passed through the fundamental rules, he is made to apply his knowledge to business transactions in the currency which he is daily using, and is thus made to feel that arithmetic means something in life."

Reviews are so arranged that the "pupil entering almost any stage of progress will be required to review all the subjects over which the class have passed, . . . thus avoiding the necessity of turning the class back on account of a few of its members."

The book has a grey board back with a black leather binding. The paper is of good quality. The type is only slightly below average newsprint size and is well spaced. The book contains 394 numbered pages, the printed space on each full page measuring about 4¼ by 5⅛ inches. Each full page contains the approximate equivalent of 306 six-letter words.

In the preface to Dean's *The Intermediate Arithmetic* are some concise statements indicating the author's concepts regarding the presentation of written arithmetic to beginners, for whom this text was written:

> Such learners are generally at that age at which *instruction* and *manual drill* are the principal things needed. Comparatively few of them are benefited by meeting difficult problems, or undertaking discussions of principles which call for profound thought of maturer minds; and even those few should first acquire familiarity with the principles and processes of arithmetic, before their minds are severely tasked in their application. Indeed, the experience of educators plainly teaches that most minds find in the science itself, however simply presented, enough of educational discipline for their faculties. Hence it is that a great majority of youth either do not go through their first book of Written Arithmetic, or do not advance beyond it. A book, therefore, which is best adapted to the average of their wants, should be so complete in its range of topics as to present all the practical applications of the science to the wants of common life, and so simple in exercises as to instruct the intellect and drill the powers without obstructing progress.

The author further points out that he has paid special attention to adapting his book to "the circumstances of recitation and class drill." He says, "for this purpose exercises and models of answer, explanation, and analysis have been given in abundance, yet so brief, logical, and complete, that the time and labor of recitation will, by following them, be fully economized."

The copy of Dean's text available for this analysis has a grey board back with a black leather binding. The paper is of good grade and the type is smaller than average for books prepared for this grade level today. Questions and illustrations or examples with ex-

planations are set in very small type and rules are set in italics. Each full page contains approximately 3½ by 5⅞ inches of printed space, or the approximate equivalent of 380 six-letter words.

Greenleaf's *Introduction to the National Arithmetic*, according to a note on the back of the title page, was an authorized text for the public schools of Philadelphia and New York City. The author says of the book:

> The arrangement is strictly progressive; the aim having been to introduce subjects in an order most in accordance with the laws governing the proper development of the mind. The rules have generally been deduced from the analysis of one or more questions, so that the reasons for the methods of solution adopted are rendered intelligible to the pupil; no knowledge of a principle being required, that has not been previously illustrated and explained.

He further points out that great care was taken to state rules, definitions, and illustrations in simple, precise, and accurate language. He says that the examples are practical, "adapted not only to fix in the mind the principles which they involve, but also to interest the pupil, exercise his ingenuity, and inspire a love for mathematical science." In presenting reasons for the processes he says that he has attempted to develop in the learner's mind "a knowledge of the philosophy of the subject, and prevent the too prevalent practice of merely performing, mechanically, operations which he does not understand." Analysis has been emphasized and abridged operations which might be considered as labor-saving processes applicable to business transactions have been included. Obsolete rules and distinctions have been omitted. An attempt has been made, through extensive correspondence and research, to make the treatment of money, weights, measures, interest, and duties conform to the then current usage and recent legislation. The author also points out that he has inserted questions at the bottom of each page "to direct the attention of teachers and pupils to the most important principles of the science, and fix them in the mind." He insists, however, that the teacher should not confine himself servilely to these questions.

Regarding the aim, Greenleaf says:

> The object of studying mathematics is not only to acquire a knowledge of the subject, but also to secure mental discipline, to induce a habit of close and patient thought, and of persevering and thorough investigation. For the attainment of this object, the examples for the exercise of the pupil are numerous, and variously diversified, and so constructed as necessarily to require careful thought and reflection for the right application of principles.

The copy of Greenleaf's text used for this study has a light green board back with a black leather binding. The paper seems to be of good quality. It has 330 numbered pages, each full page containing approximately 3½ by 6 inches of printed space. All of the print is quite small and that used for examples, illustrations, explanations, and questions is especially small. Each full page contains approximately 451 six-letter words.

In his preface to *Felter's New Practical Arithmetic*, Peabody makes some very emphatic observations regarding the teaching of arithmetic:

As a discipline written arithmetic is useless, and even harmful, unless guided and controlled in the minutest step by logical analysis. Mental arithmetic, without the assistance of visible figures in all complex questions, is tiresome and unfruitful toil, save to minds of singular arithmetical acuteness. Sound sense would seem to dictate these principles:—

I. Refrain from written work so long as the exercise of the memory in retaining what the logical faculty acquires does not require more attention than the logical faculty itself.

II. In the written work let no figure or sign be written until the writer thereof knows what it means, and why it is so written. Step by step the analytical mental process must precede the visible form. There must be no magic, no mechanism, none of the "working by rule," and none of the "figures won't lie." The figures are merely the visible symbols of mental acts.

The author also sets forth his belief in the inheritance of learning faculties. He says:

The arithmetical, that is, the logical faculty, is the common inheritance of children. A few are born without it, as some are by nature color-blind, and some lack fingers or feet. About as many are endowed with a supernatural acuteness, like Blind Tom in music; they writhe in travail for an instant, and produce the most incredible results, themselves scarcely know how. Obviously neither of these classes can be taught. But they are numbered by units. The millions can learn arithmetic, and the many and various avenues by which they may be reached all lie through the common logical faculty called *common sense.*

Peabody points out that he has attempted to bring his book to the standard which he has set forth. Therefore, he gives considerable emphasis to analyses.

The book is divided into three parts, the first being a review of the fundamental rules and properties of numbers; the second dealing with commercial arithmetic, including fractions, compound numbers, and percentage; and the third including mensuration and mechanics. Review questions are inserted frequently at the bottom of pages, and questions for examinations are given at the end of each major division of the book.

In the first part of the book decimals are treated as regular orders of numbers instead of as fractions, the advantage cited for this procedure being "the early and logical use of questions involving United States money." In the second part of the book the author has attempted to simplify and clarify the materials on common and decimal fractions which appeared in Felter's arithmetic. In commenting on the third part, the author states that he has given ratio and proportion more than usual emphasis despite the fact that fashion at the time frowned upon it. The reason which he gives for the added emphasis is that these processes "are really invaluable in all applied mathematics." He has attempted, he says, to clarify the reasons for mensuration without rigorous geometrical proofs. In treating mechanics he has attempted to present the most useful ma-

terials by methods which are "simple, readily comprehended, thoroughly logical, and free from empiricism." He approaches the subject through its applications to work and points out that to his knowledge this point of attack has not "hitherto been chosen in American textbooks, though for some time adopted by English writers of authority." Teachers are urged by Peabody not to be slaves to the text.

The copy of this textbook available for the analysis is in good condition. It has a light blue board back with black leather binding. The paper is of good quality. Exclusive of the answer key, the book contains 347 numbered pages, each full page containing approximately 3½ by 6 inches of printed material. The type is moderately small and some of it, especially that devoted to examples and their explanations and to questions, is very small. Each full page contains the approximate equivalent of 387 six-letter words.

The preface to Peck's *Complete Arithmetic* contains the statement that the book is an attempt "to present, within moderate limits, all the principles of arithmetic required by the student, the man of business, and the artisan." Further indications of the aims of the author may be seen in the following quotation:

> It is believed that a careful examination of the work will show that all parts are arranged in logical order; that the definitions and explanations are plain and concise; that the principles are stated clearly and accurately; that the demonstrations are full and complete; that the rules are perspicuous and comprehensive; and, finally, that the whole subject is amply illustrated by numerous graded examples and corresponding practical problems.

The author has also written a more elementary text, called the *Manual of Practical Arithmetic*, which was intended for use preceding the *Complete Arithmetic*, but these books were so designed that they could be used independently of one another if desired, and only the one book has been included in this study.

The general order of content dealing with each process or operation is: definitions, principles, examples with explanations, rules, drill problems, practical (written) problems, and examination questions. The units of content are presented in the following order: general definitions and principles; fundamental operations, including factoring, cancelling, common divisor, and common multiple; fractions, common and decimal, and United States currency; compound numbers; ratio, proportion, and analysis; percentage and its application to business; powers, roots, progressions, and annuities; mensuration; and miscellaneous problems.

Peck's text has a light grey board back with a black leather binding. It is written on good paper and contains 310 numbered pages, excluding the answer key. Each full page contains approximately 3½ by 5¾ inches of printed space. The type is well spaced and is approximately the same as that found today in grammar school texts. Statements of principles and rules are printed in italics, and questions are presented in very small type. Each full page contains the approximate equivalent of 293 six-letter words.

The two books by French are analyzed as one text. In the preface to French's *First Lessons in Numbers*, the more elementary of the two textbooks, is the following statement of purpose:

This little book is intended to give to young children clear ideas of the elementary combinations of numbers, and some practical knowledge of their applications to the business affairs of life.

The book is divided into 15 sections, the first dealing with counting; the next eight with the four fundamentals; three with fractional parts; one with miscellaneous problems; one with tables of money, weights, and measures; and the last with combinations, using tables of the fundamental processes and of factors and fractions. Each section is divided into articles dealing progressively with numbers from one up.

Frequently pictures and examples are included. In the preface it is stated:

The cuts are not mere counters, picked up at random; but are pictures which will cultivate the taste of the child, and impart useful knowledge, besides assisting him in his first steps in numbers; and the examples contain much valuable information upon the various occupations, trades, and branches of business, that can not fail to enlist the interest of children in the study of the book.

The last 12 pages of the book are given over to a manual of directions for the teacher. These are "not intended as arbitrary directions and rules; but are to be adopted, adapted, or rejected according to circumstance." In this manual the importance of oral instruction is emphasized. The teacher is urged to be energetic but not to pass too rapidly over a subject or lesson. Understanding as a goal is stressed.

It is suggested that, in order to discourage verbatim memorization, the pupils should be allowed to use their texts in class generally, unless the lesson deals with abstract combinations. In reviews it is urged that pupils be encouraged to solve the problems in various ways and that the different solutions be compared until the ingenuity of the class and the understanding of the examples have been fully tested. It is also recommended that the blackboard and slates be used daily —the teacher setting models on the board and the pupils copying them on slates.

The book is bound in a light green board back with leather binding. It contains 120 numbered pages, each full page containing about 3¼ by 5⅛ inches of printed matter. Most of the print is near the average size of that found in the more advanced books today. Miscellaneous problems and notes, however, are set up in very small type. Each full page contains the approximate equivalent of 254 six-letter words.

In the preface to French's *Common School Arithmetic*, the second book in the series, it is pointed out that business men generally agree that the arithmetic which they had learned in school was not adapted to use in business. This realization led the author to the conclusion that, "in order to make *practical arithmeticians*, a radical change in the plan of textbooks upon the subject is necessary."

In speaking of methods of instruction, he says the requisites of good method are:

1st. It must be adapted to the nature of both subject and learner;
2d. It must be an uninterrupted progress from the easy to the difficult;
3d. It must use facts known to the learner, in imparting to him a knowledge of the unknown subject;
4th. It must regard the natural order of development of the subject, and present it in that order;
5th. It must arrange the substance of the facts presented under each general division, into brief summaries, recapitulations, or general principles;
6th. It must thoroughly reach the understanding of the learner.

The author points out that he has attempted to arrange the subjects in a philosophical order. This order is: integers, decimals, compound numbers, factors and multiples, fractions, converse operations (the various operations in numbers which are converse to each other), percentage, ratio and proportion, evolution, progression, mensuration, and miscellaneous problems.

In presenting the materials of this book, the inductive process is used. Principles are presented as the sequents of introductory exercises; these principles are then applied to a number of problems, and the rules based on these principles are then presented.

In preparing the problems of this book French has attempted "to make them the vehicle of practical knowledge." In referring to the various occupations, trades, professions, and arts, he points out that he has attempted to use common business terms and articles of commercial exchange with their appropriate market values, peculiar to each. In this way he has hoped to make the arithmetic of the schoolroom meet the interests of the pupils and the practical wants of after-school life.

Following the preface French gives four pages of very small print to a manual of methods and suggestions to the teachers. These suggestions are given for the teaching of materials on particular pages of the text. They include comments on suitable approaches, amount of practice, nature of supplemental work which might be of value, etc., which might be helpful in presenting the content.

The copy of the book used for this study has a light green board back with black leather binding. It has 348 numbered pages, each full page containing about 3½ by 5¾ inches of printed material. The type is small throughout the book; however, definitions and most examples and explanations are set in larger type than are statements of problems and notes. Rules and principles are set in italics. Each full page contains approximately 362 six-letter words.

In the introduction to Hagar's *A Common School Arithmetic* it is stated that the text is to serve as a complete manual for those who "advance beyond the first lessons in Numbers." It is further stated that:

All obsolete and valueless material and all merely puzzling problems have been excluded, but no pains have been spared to embody

valuable modern methods of computation and topics have direct relation to business as it is transacted at the present day.

The work is sufficiently comprehensive to render the use of higher arithmetic quite unnecessary. It is ample enough in its range of subjects and exercises to qualify the learner for a skillful and prompt solution of all ordinary problems of a commercial character, and at the same time to subserve the purposes of mental discipline.

Included in the appendix of the book, it is pointed out, are "applications of a technical nature useful to farmers, artificers, and others; also, problems and topics for examinations, enforcing thoroughness and testing the progress of the learner."

Following the introduction the book contains a page of suggestions to teachers. It is pointed out here that the teacher should carefully prepare every lesson so that he may be able to present the material clearly and with familiar illustrations when necessary. Pupils should be grouped according to their achievement, and the class exercises should be varied. It is further urged that indefinite answering of questions should not be tolerated. Cultivation of the habit of self-reliance is suggested as a goal.

The importance of mental arithmetic is emphasized in the introduction, and it is pointed out that the "plan of the book is to combine mental and written exercises, and to require a reason for every process." It is further urged:

The proficiency of the learner should be often tested with problems not found in the book. Require, as an occasional test, the formation of problems and their solution without regard to rules.

The book has a light grey board back with a black leather binding. It is printed on good paper and contains 360 numbered pages, each full page containing about 3½ by 6 inches of printed matter. Most of the type is approximately the same size as the average type used today in advanced textbooks. Examples and their explanations and test questions are set in very small type, while rules are set in italics. Each full page contains approximately the equivalent of 358 six-letter words.

The two books by Mecutchen and Sayre comprise the second series included in this study. In the preface, *The New American Arithmetic, Part I*, the beginner's text, points out that an attempt has been made "to present the first principles of Arithmetic in a simple and practical manner, without theorizing upon them." The pedagogical thinking of the authors is stated concisely as follows:

It has been too much the fashion of late to attempt the development of the reasoning powers of children of tender years. Nature dictates a different course. The perceptive faculties are in full vigor during childhood, whilst the ability to reason is slow of growth, and seldom capable of rapid development early in life without risk of serious injury.

The book is prepared with oral and written exercises on alternate pages, and has been designed to develop quickness and accuracy in the fundamental combinations.

The authors further state:

Illustrations and explanations have been left to the teacher, this being emphatically intended for a working *text-book*, and not a pictured *play-book*. We hold that there are no means of gaining a proper knowledge of this or any other science save constant labor and practice.

The book used has a brown board back with a red oilcloth binding. The type is relatively large as compared to other arithmetics of this unit; it is comparable on the average to the size of type found in third or fourth grade books today. The book has 84 numbered pages, each full page containing about 3½ by 5¼ inches of printed matter and the approximate equivalent of 216 six-letter words.

Mecutchen and Sayre's *The New American Practical Arithmetic* is a combination of Parts II and III of *The New American Arithmetic* series. The authors point out that the experiences of the most eminent educators indicate that, when oral arithmetic has been separated as a distinct study, it has often "failed to increase the ability of the pupil to master written exercises." Therefore the authors use oral exercises as introductory, leading up to written work, in the hope that the procedure will enable "the pupil to arrive at the reasons for the methods employed, and make him to a certain extent the author of his own rules."

The book has a light grey board back with a black leather binding. It is printed on a good quality of paper and contains 308 numbered pages, each full page containing approximately 3½ by 5½ inches of printed material. Most of the type is as large as that usually found today in advanced elementary texts. Examples and explanations are set in small type and rules in italics. Each full page contains the approximate equivalent of 307 six-letter words.

In the preface to his *The Practical Arithmetic*, W. J. Milne points out that he has endeavored to include within the bounds of the text "all of the essentials for *A Practical Course in Arithmetic*, and to present every subject in such a manner as to secure the highest mental development of the learner." He states that he has attempted to include in the text all the arithmetic content essential to a business education.

Milne presents his work by the inductive method, introducing each section by simple exercises which are followed in general order by definitions, principles, tables involved in the process, oral examples analyzed, oral problems, written examples analyzed, written and drill problems, rules, and a few miscellaneous problems. Analysis as a method of solution is emphasized.

In adapting his text to the needs of business, the author points out that:

In the problems given for solution it has been the aim of the author to use the language of trade, when no error is conveyed thereby, thus accustoming the student to the forms of expression needed in after life; and in general the author has striven after clearness of statement rather than technical accuracy of expression.

He also suggests that in his belief "a careful examination of the book will exhibit the logical sequences of the steps in all the processes, the perspicuity and accuracy of the analyses, and the brevity and correctness of the definitions, principles, and rules."

The copy of Milne's text used for this analysis has a grey board back with black leather binding. Exclusive of pages devoted to test questions and of the answer key at the end of the text, the book has 362 numbered pages. Each full page contains approximately 3½ by 5½ inches of printed space. Most of the type is a little smaller than that found in most grammar school arithmetics today, but it is well spaced on a good grade of paper and therefore is easily read. Solutions of examples are set in very small type, and principles and rules are set in italics. Each full page contains the approximate equivalent of 334 six-letter words.

Raub points out in the preface to *The Complete Arithmetic* that his book is an attempt to meet the need for a shorter course in arithmetic. He states that teachers generally were beginning to recognize that mental or intellectual arithmetic can best be taught in connection with written arithmetic, that the intellectual process is just as necessary in the solution of written as of oral problems. Oral exercises and their analysis are included, however, as preliminary to written exercises, but Raub has attempted to avoid carrying them "to such an extent as to make them mere puzzles for testing the retentive power of the pupil's memory."

The author believes that his book is systematically arranged from the simplest oral to the most complex written solution. He has also attempted to make the problems practical by drawing them from business interests and presenting them in such a manner as to invoke thought.

Regarding the method employed and the expected outcome, Raub states:

> As the pupil gains growth in the proper use of language, he is called upon, in many cases, to give his own explanation of written solutions; and as his mental strength increases still more, he is required to frame his own rules from the preceding solutions and principles. Thus he is trained to think from the beginning, and master the whole subject in such a way as will not only make him a thorough practical arithmetician, but at the same time develop in him sound mental strength.

Following the preface the text contains a little more than a page of suggestions to teachers. Among these are the suggestions that the teacher present a great many supplementary exercises from other sources; that problems which combine several processes will do much to stimulate thought; that there should be thorough and frequent drills on all the fundamental rules; that slate and board work in written arithmetic should be neat and in proper order; and that pupils should be required to present their solutions, analyses, and explanations in grammatical language. Teachers are also urged to give problems frequently from actual business operations, and to have the pupils make problems of their own to illustrate the principles

and rules. The last admonition is, "Be sure that the pupils understand each part of their work before they pass on to the next. Be thorough!"

The copy of Raub's book available for analysis has a brown cloth-covered board back, and the pages are considerably yellowed with age. It contains 342 numbered pages, each full page containing approximately 3½ by 5¾ inches of printed space. The type is small for an elementary school text, though not extremely so. Examples and their explanations are in very small type and rules are set in italics. Each full page contains approximately the equivalent of 370 six-letter words.

The third series of two books included in this analysis was written by Joseph Ray. The more advanced of these texts was written in 1877 and the elementary arithmetic in 1879.

According to the preface of *Ray's New Practical Arithmetic*, the book is a revision of a former volume. It is pointed out that no other arithmetic had such wide usage as this earlier text. In the revised text it is stated that an attempt has been made to preserve its distinctive feature, that is:

> 1st. Every principle is clearly explained by an *analysis* or *solution* of simple examples, from which a rule is derived. This is followed by graduated exercises designed to render the pupil familiar with its application.
> 2d. The arrangement is strictly philosophical; no principle is anticipated; the pupil is never required to perform any operation until the principle on which it is founded has first been explained.

The copy of the book used for this analysis has a light blue-grey board back with a red leather binding. It contains 336 numbered pages, each full page containing approximately 3½ by 5¼ inches of printed space. Most of the type is of average size, approximately the same as that found in advanced textbooks today. Examples and their explanations are set in very small type and rules in italics. Each full page contains the approximate equivalent of 305 six-letter words.

Ray's Elementary Arithmetic, according to the preface, was prepared to serve as the introductory book of a two-book series. It is a revision of an earlier beginning text by the same author, in which an attempt has been made to provide "a thorough knowledge of fundamental rules with some knowledge of fractions and common tables."

With regard to method of presentation, it is suggested that the beginning number combinations should be drilled on constantly until the pupils have thoroughly mastered them. It is recommended that such drill should be carried out with the use of objects. An effort was made to avoid confusion in the minds of pupils by presenting each subject in one concise, simple, clear form, giving a model solution with complete explanation and then applying that procedure to succeeding examples. It is recommended that the teacher supplement the book explanations in order to bring about thorough understanding and that she endeavor constantly "to ascertain just what part the

pupil fails to understand, and to aid him by suggestion rather than by an attempt at exhaustive explanation."

The copy of the book used in this study has a light blue-grey board back with a red leather binding. It has a total of 192 numbered pages, each full page containing approximately 3½ by 5½ inches of printed space. Most of the print is of the size found today in the average advanced elementary book. Examples, with solution, explanations, and notes, are set in very small type, and rules are set in italics. Each full page contains approximately the equivalent of 306 six-letter words.

Regarding his purpose in preparing his *Elementary Arithmetic*, Baker states:

> In its preparation I have endeavored to give it not only a mathematical basis, but also a scientific structure. This I have done, keeping steadily in mind that it is a book for the young, for whom the pathway of science should be made as easy and inviting as possible.

Regarding the method of teaching, Baker recommends strongly the use of the blackboard, at which pupils are to demonstrate theorems or the solving of problems while other members of the group attentively observe their work. He points out also that the teacher should serve as the guide to the class, attempting to encourage and interest the pupils, providing exemplification and observing pupil progress.

The text is the second book of a series and seems to have been intended for use in the upper portion of the common school. Though the book covers a wide scope of topics, it is considerably shorter than most of the contemporary arithmetic texts. The publisher states:

> It is more simple and comprehensive. It saves time and labor, and renders the study of mathematics easy and interesting.
>
> All extraneous matter has been discarded, laying bare the science, in order that the principles may be readily discerned, and after a complete analysis, thoroughly developed and systematized, and thereby rendered brief and explicit.

The copy of Baker's book used in this analysis has a light blue board back with a black grained oilcloth binding. It contains 120 pages, each full page containing approximately 3⅜ by 5¼ inches of printed space. The type is about the same size as that found in most advanced elementary school texts today. A few notes are set in very small type, and a few theorems in italics. Each full page contains the approximate equivalent of 284 six-letter words.

Olney's *A Practical Arithmetic* is the second book of a two-book series for the elementary schools, the first book not being available for this study. According to the preface, the author has attempted to emphasize more of the practical and less of the theoretical in this text. He states:

> All statements of principles, definitions, and rules are reduced to the most brief and simple language consistent with clearness and accuracy; and all demonstrations, illustrations, and methods of solution are made as explicit, direct, and practical as possible.

Olney points out that this text is largely a revision of an earlier work and that he has attempted to make use of the suggestions of many friends. As a result of these suggestions, he has aimed at developing a textbook that contains fresh and practical problems and a thorough exposition of principles, and yet that is "a *book of work* for the pupil" rather than a book, like his earlier text, which emphasizes the development of a method of teaching.

Mental and written arithmetic are not presented separately; instead, the former has been thoroughly incorporated in the latter.

The copy of Olney's text used in this analysis has a dark grey cloth-covered board back with black leather binding. Exclusive of the answer key it has 378 numbered pages, each full page containing approximately 3½ by 5½ inches of printed matter. The paper is of very good quality and the type, on the whole, is nearly as large as the average size found in advanced textbooks today. Examples and notes are set in very small type, and principles and rules are set in italics. Each full page contains the approximate equivalent of 328 six-letter words.

RESULTS OF THE ANALYSIS

As pointed out in the introduction, the space given to each detailed aspect of content in the 16 textbooks analyzed for this period has been tabulated. These many topics have then been grouped under major headings, the results being arranged in table form showing the total amount of space given to each of the major topics in each book. Since the pages of the various books are not identical in size, the total number of six-letter words on each full page of each book has been estimated and, in order to place them on a comparable basis, the ratio between this number and a standard 400-word page has been calculated. The numbers in each column of the original table have been multiplied by the ratio determined for the text represented by that column.

Table VI gives the names of the major topics and the number of standard 400-word pages of space devoted to each of these topics in each book.

Space given to each topic.—Of the entire group of books, French's series is the longest in terms of standard 400-word pages (344.91) and Baker's *Elementary Arithmetic* is the shortest, with only 71.50 pages. Eleven of the books have more than 250 standard pages, and two, both of which are series, contain more than 300 pages each. Baker's is the only text having less than 190 pages.

According to Table VI, all 16 books treat arithmetic symbols, arithmetic (general aspects), total numeration, total fundamental processes in whole numbers, total vulgar (common) fractions, total decimals, measures (tables and their uses), total compound denominate numbers, total geometric forms, total percentage, partial payments, ratio, and total powers and roots. Major topics treated in only one or two books are barter; bonds; building association business; construction workers', farmers', and painters' estimates; and mechanics.

TABLE VI. NUMBER OF 400-WORD PAGES GIVEN TO EACH TOPIC IN ARITHMETIC TEXTBOOKS FROM 1851 TO 1880

Topic	Dodd, James B., *Elementary and Practical Arithmetic*, 1854	21	Eaton, James S., *The Common School Arithmetic*, 1862	22	Colenso, Right Rev. J. W., *Arithmetic Designed For the Use of Schools*, 1864	23	Pelter, S. A., *The Analysis of Written Arithmetic (Book Second)*, 1864	24	Dean, Philotus, *The Intermediate Arithmetic*, 1865	25	Greenleaf, Benjamin, *Introduction to the National Arithmetic*, 1867	26	Peabody, Selim H., *Potter's New Practical Arithmetic*, 1872	27	Peck, William G., *Complete Arithmetic, Theoretical and Practical*, 1874	28	French, John H., *First Lessons in Numbers*, 1874; and *Common School Arithmetic*, 1875	29	Hagar, D. B., *A Common School Arithmetic*, 1877	30	Meetchen, S., and Sayre, G. M., *The New American Arithmetic, Part I*, 1877; and *The New American Practical Arithmetic*, 1877	31	Milne, William J., *The Practical Arithmetic on the Inductive Plan*, 1877	32	Raub, Albert N., *The Complete Arithmetic*, 1877	33	Ray, Joseph, *Ray's New Practical Arithmetic*, 1877; and *Ray's Elementary Arithmetic*, 1879	34	Baker, Andrew H., *Elementary Arithmetic*, 1878	35	Olney, Edward, *A Practical Arithmetic*, 1879	36	Subtotal	Total
Arithmetic symbols	.97		1.37		.34		1.34		1.00		1.07		2.37		1.43		1.40		1.43		.30		1.63		.65		1.57		.53		.94			
Arithmetic (general aspects)	2.11		.49		.11		8.68		1.33		.28		6.97		.18		.86		2.55		.15		.25		.46		.73		.78		.12			18.34
Total numeration	5.31		9.50		2.47		6.89		9.74		10.15		8.18		6.74		11.97		9.39		3.59		9.52		4.12		15.89		2.91		9.78			26.05
Numeration by words and Arabic symbols	5.31		8.09		2.18		5.97		8.27		8.74		7.31		6.12		11.91		8.83		3.59		7.85		3.70		14.05		2.91		7.94		112.57	126.15
Numeration by Roman numerals	0		1.41		.29		.92		1.47		1.41		.87		.62		.06		.76		0		1.67		.42		1.84		0		1.84		13.58	
Total fundamental processes in whole numbers	30.97		42.17		16.99		27.46		40.61		46.85		26.08		29.96		95.65		42.24		44.90		55.32		32.38		72.67		16.09		50.90			671.24
Addition and subtraction of whole numbers	.08		1.02		0		.11		0		0		3.05		0		20.38		3.04		1.46		b		0		1.68		2.87		.41		34.10	
Addition of whole numbers	4.33		5.90		1.61		4.51		8.27		9.13		3.68		4.36		7.33		6.71		10.96		10.31		5.96		15.51		.99		8.64		108.20	
Subtraction of whole numbers	3.60		4.19		1.26		3.60		6.03		7.84		3.87		4.65		7.51		4.61		10.07		5.85		4.34		10.08		.67		7.53		85.70	
Multiplication and division of whole numbers	.12		0		0		.27		0		0		0		0		22.50		0		1.11		0		0		0		2.59		0		26.59	
Multiplication of whole numbers	7.21		9.02		3.79		5.58		7.17		11.95		6.24		6.52		11.27		9.08		12.04		11.94		6.33		14.78		3.65		12.90		139.47	
Division of whole numbers	15.63		22.04		10.33		13.39		19.14		17.93		9.24		14.43		26.66		18.80		9.26		27.22		15.75		30.62		5.32		21.42		277.18	
Total vulgar (common) fractions	21.74		29.15		26.97		51.71		27.70		30.33		33.84		19.81		36.64		26.81		24.42		34.07		35.95		39.14		9.95		33.86			482.09
Vulgar fractions (general)	5.83		17.84		16.07		29.95		13.78		13.76		15.58		8.20		23.86		14.19		13.40		16.62		20.10		19.58		.85		17.36		246.97	
Cancellation of fractions	.32		0		0		1.99		1.85		1.52		1.36		2.20		0		.94		1.11		1.75		1.20		3.01		1.56		5.73		24.54	

TABLE VI—CONTINUED

Aliquot parts	1.54	.10	0	.11	.29	0	.15	1.14	2.05	1.97	0	2.13	0	1.56	.14	3.11	14.29	
Addition and subtraction of fractions	2.51	0	0	4.32	0	0	3.00	0	3.67	0	1.11	0	0	.08	1.91	1.02	17.62	
Addition of fractions	1.82	1.76	2.24	3.52	2.28	2.03	2.32	1.57	0	1.12	1.54	2.13	2.13	2.67	0	1.11	28.24	
Subtraction of fractions	2.92	1.95	1.95	2.30	2.19	3.78	1.36	1.65	0	1.21	1.00	1.63	2.59	2.86	0	.78	28.17	
Multiplication and division of fractions	0	0	2.87	.27	0	0	1.60	1.57	0	0	0	0	0	0	1.70	0	8.01	
Multiplication of fractions	3.28	4.53	2.12	3.44	3.56	4.90	5.08	1.50	2.90	3.58	3.11	4.01	5.08	4.46	1.38	3.48	56.41	
Division of fractions	3.52	2.97	1.72	5.81	3.75	4.34	3.39	1.98	4.16	3.80	3.15	5.80	4.85	4.92	2.41	1.27	57.84	
Total decimals	17.49	14.58	16.47	25.63	12.35	12.63	11.42	9.86	21.53	12.72	11.06	15.49	9.70	19.60	2.30	15.73		228.56
Decimals (general)	5.63	9.51	13.66	9.91	7.93	6.09	7.02	5.02	10.86	8.06	7.26	8.06	5.17	11.15	.99	7.74	124.06	
Addition of decimals	1.74	.83	.29	4.36	.86	.96	0	1.03	1.58	.63	.61	1.09	.65	1.80	0	.41	16.84	
Subtraction of decimals	1.86	.68	.11	2.18	.76	1.92	0	1.10	1.67	.40	.61	1.00	.46	1.68	0	.78	15.21	
Multiplication of decimals	3.60	1.61	.69	4.82	1.33	1.86	2.08	1.50	2.49	1.75	1.08	3.38	2.63	1.99	.78	3.24	34.83	
Division of decimals	4.66	1.95	1.72	4.36	1.47	1.80	2.82	1.21	4.93	1.88	1.50	1.96	.79	2.98	.53	3.56	37.62	
Duodecimals	3.60	3.95	1.49	0	3.23	2.99	0	1.57	0	1.57	.27	0	1.48	0	0	0		20.15
Federal money	3.16	5.70	.75	4.25	8.88	7.78	3.63	5.16	6.73	7.79	10.78	1.50	7.58	17.96	0	5.86		97.51
Measures (tables and their uses)	5.18	6.00	9.70	8.07	7.93	15.45	15.34	10.22	14.62	10.52	11.76	9.98	9.19	16.81	3.40	11.88		166.05
Total compound denominate numbers	15.27	25.65	26.64	17.37	24.23	32.82	29.67	17.99	28.29	20.31	14.51	19.08	18.53	39.79	7.19	26.83		364.17
Compound denominate numbers (general)	1.01	4.83	5.45	4.82	2.04	2.65	11.37	.70	5.11	1.61	.15	3.55	2.13	8.41	.74	11.88	66.45	
Addition of compound denominate numbers	1.78	2.93	3.27	.04	3.23	3.89	1.89	2.86	2.67	2.15	1.15	1.63	2.13	4.55	1.42	1.68	37.27	
Subtraction of compound denominate numbers	2.31	3.02	2.64	.88	4.85	3.50	1.06	2.56	3.67	2.19	1.34	1.67	2.03	4.96	.92	4.26	41.86	
Multiplication of compound denominate numbers	1.66	4.10	2.41	1.11	1.95	4.00	.44	2.16	1.99	2.01	1.00	.71	.97	3.17	.85	.70	29.23	
Division of compound denominate numbers	1.58	2.19	4.19	1.42	3.28	3.33	3.58	3.74	3.67	1.43	1.65	1.25	.23	3.05	.64	1.39	36.62	
Reduction of compound denominate numbers	6.93	8.58	8.68	9.10	8.88	15.45	11.33	5.97	11.18	10.92	9.22	10.27	11.04	5.65	2.62	6.92	152.74	
Bills and accounts	0	1.37	0	.61	1.14	1.75	0	1.06	.68	2.91	3.15	3.26	2.68	2.60	0	2.25		23.46
Exchange	0	4.49	3.61	6.92	4.42	4.23	3.24	3.77	2.17	5.37	3.15	5.64	4.71	3.01	1.81	4.71		61.25
Total geometric forms	14.99	8.15	4.87	13.01	10.83	15.95	23.71	12.19	9.19	21.61	20.01	12.99	15.62	12.36	1.38	12.41		209.27
Geometric forms (general)	7.90	4.49	.40	6.39	3.42	8.40	12.39	5.27	3.94	9.93	9.41	4.76	9.33	4.35	.64	3.48	94.50	
Areas of geometric forms	4.78	2.05	2.58	3.98	4.37	4.79	7.79	2.45	3.62	3.49	4.11	5.64	3.10	6.14	.74	5.08	64.71	
Volumes of geometric forms	2.31	1.61	1.89	2.64	3.04	2.76	3.53	4.47	1.63	8.19	6.49	2.59	3.19	1.87	0	3.85	50.06	

TABLE VI—CONTINUED

Topic	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Sub-total	Total
Total percentage	16.04	31.80	21.01	35.22	30.46	34.10	44.28	29.69	37.79	38.36	32.27	52.32	46.67	38.86	7.26	45.49		541.62
Percentage and its application (general)	7.90	3.75	.69	7.61	2.90	1.80	8.76	4.58	10.23	7.97	6.14	9.94	9.06	6.75	.28	6.92	95.28	
Commission, brokerage, and insurance	.28	4.39	3.39	4.93	3.90	3.21	8.32	4.72	5.07	6.18	9.29	11.48	8.36	4.19	2.23	6.55	86.49	
Insurance	.12	1.56	1.38	1.34	1.66	.96	4.26	1.94	1.99	1.16	.65	4.01	2.82	2.55	0	2.62	29.02	
Profit and loss	0	4.73	2.12	4.40	3.42	5.75	2.37	2.34	1.58	1.83	1.38	9.06	5.04	1.22	0	3.11	48.35	
Discount	2.03	2.83	3.10	2.75	5.80	4.23	3.29	3.92	1.45	4.61	1.08	6.18	5.08	9.66	1.13	8.15	65.29	
Interest (general)	.65	1.32	2.01	2.37	.52	.56	3.58	.07	2.13	2.46	2.61	2.80	.65	1.03	1.88	2.29	26.93	
Simple interest	4.98	8.39	5.91	10.02	7.55	10.77	12.49	7.18	12.90	10.61	5.91	6.51	10.30	12.28	1.74	13.47	141.01	
Simple interest in annuities, etc.	0	.59	0	0	.67	1.52	0	2.60	0	1.97	2.07	0	1.71	0	0	0	11.13	
Compound interest	.08	3.17	2.41	1.80	2.76	3.33	1.21	2.34	2.44	1.57	.84	2.34	2.40	1.18	0	2.38	30.25	
Compound interest in annuities or pensions in arrears	0	1.07	0	0	1.28	1.97	0	0	0	0	2.30	0	1.25	0	0	0	7.87	
Partial payments	16.32	15.11	1.78	15.95	11.26	11.61	12.58	8.72	12.81	9.98	7.49	8.73	7.44	4.57	1.52	8.11		151.98
Ratio	1.09	1.71	4.02	1.26	2.33	1.52	4.60	1.32	1.27	1.66	2.00	2.13	1.06	3.55	5.07	1.92		36.51
Alligation	3.52	5.31	.92	4.28	5.04	4.90	2.95	0	0	0	4.65	0	3.47	1.11	3.12	0		39.27
Proportion	7.74	13.41	26.05	5.93	9.41	9.19	13.36	8.39	5.20	8.01	4.53	6.85	10.86	6.21	0	6.31		141.45
Total partnership	2.47	3.51	0	2.68	3.05	4.06	1.84	0	3.53	4.29	3.07	3.67	3.51	1.71	0	.74		38.13
Partnership (general)	0	.29	0	.96	.29	.34	.92	0	.63	.98	.19	.92	.23	.99	0	0	6.74	
Simple fellowship or partnership	1.90	0	0	1.11	1.00	1.30	0	0	1.86	1.52	1.15	1.46	1.34	0	0	0	12.64	
Double fellowship or partnership	.57	3.22	0	.61	1.76	2.42	.92	0	1.04	1.79	1.73	1.29	1.94	.72	0	.74	18.75	
Longitude and time	0	2.44	1.32	0	3.66	0	2.03	0	2.25	1.61	1.50	2.25	3.00	1.60	.89	2.74		25.29
Total powers and roots	11.99	15.55	5.51	6.62	15.35	15.05	10.60	4.58	10.05	14.36	11.28	15.61	5.69	11.37	4.86	7.87		166.34
Powers and roots (general)	.93	0	2.81	.11	0	0	.68	0	0	0	2.38	0	.28	0	0	0	4.81	
Involution or raising of powers	.53	2.10	0	.73	2.71	1.52	2.71	.77	1.00	2.28	8.90	2.80	.37	1.22	.18	.25	21.55	
Evolution or extraction of roots	10.21	10.53	2.70	5.78	9.93	9.53	7.21	3.81	9.05	12.08	0	7.72	5.04	9.04	2.30	6.35	120.18	
Uses of square root	.16	2.24	0	0	1.85	3.72	0	0	0	0	0	3.34	0	1.11	2.38	.82	15.62	
Uses of cube root	.16	.68	0	0	.86	.28	0	0	0	0	0	1.75	0	0	0	.45	4.18	
Total practice	0	3.80	6.88	0	0	0	0	0	5.49	2.33	0	0	0	0	0	0		18.50
Practice (general)	0	.15	.11	0	0	0	0	0	.32	.18	0	0	0	0	0	0	.76	

TABLE VI—CONTINUED

Practice in finding total value of goods when price and quantity are given	0	3.02	6.77	0	0	0	0	0	2.22	2.15	0	0	0	0	0	0	14.16	
Practice in finding price when quantity and total value are given	0	.29	0	0	0	0	0	0	1.86	0	0	0	0	0	0	0	2.15	
Practice in finding quantity that can be bought when price and total value are given	0	.34	0	0	0	0	0	0	1.09	0	0	0	0	0	0	0	1.43	
Barter	0	.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0		.39
Tare, trett, cloff, etc.	.24	.49	0	.27	.24	.39	.44	.44	.32	.27	0	.08	.37	.23	0	0		3.78
Imports and exports	0	1.66	0	1.45	1.52	1.13	2.32	.95	1.31	.13	1.15	.92	1.34	.88	0	2.01		16.77
Total progression	0	4.39	0	0	3.42	8.23	0	3.41	6.43	4.25	5.49	3.55	7.02	3.47	1.77	1.10		52.53
Arithmetic progression	0	2.29	0	0	2.33	4.34	0	2.09	3.17	2.24	2.84	2.21	4.85	1.87	1.77	.53	30.53	
Geometric progression	0	2.10	0	0	1.09	3.89	0	1.32	3.26	2.01	2.65	1.34	2.17	1.60	0	.57	22.00	
Permutations and combinations	0	.78	0	0	1.71	.85	0	0	0	0	0	0	0	0	0	0		3.34
Business forms	0	0	0	.08	.76	.85	.44	.48	1.13	.54	1.11	1.29	2.54	.23	0	0		9.45
Bonds	0	0	0	0	0	0	0	0	0	0	0	0	1.52	0	0	2.13		3.65
Building association business	0	0	0	0	0	0	0	0	0	0	1.96	0	7.02	0	0	0		8.98
Construction workers', farmers', and painters' estimates	0	0	0	0	0	0	0	0	0	3.76	0	0	0	0	0	.16		3.92
Mechanics	0	0	0	0	0	0	31.51	0	0	0	0	0	0	0	0	0		31.51
Bankruptcy	0	0	0	0	1.76	0	.87	0	0	0	0	0	0	.42	0	.12		3.17
Banking	0	1.46	0	1.84	0	.51	3.10	0	1.63	1.12	2.69	.08	.32	0	.67	0		13.42
Taxes	.20	2.49	0	2.37	1.52	2.76	2.37	1.28	1.67	3.13	.73	2.55	1.52	3.62	0	2.66		28.87
Analysis	0	1.85	4.07	0	4.85	7.61	0	4.80	.77	10.92	2.50	2.30	4.94	0	0	0		44.61
Miscellaneous written problems	12.23	6.83	32.70	14.80	3.66	11.73	0	6.67	15.40	12.84	7.56	5.72	8.32	10.14	0	0		148.60
Other miscellaneous items	0	0	0	0	0	0	0	0	8.13	.58	0	0	0	0	0	3.28		11.99
Total 400-word pages	192.63	263.55	214.67	264.69	253.39	296.77	297.74	190.67	344.91	283.36	234.03	276.78	259.66	330.10	71.50	259.91		4,038.36

The major topics given most space in all books combined are:

Total fundamental processes in whole numbers	671.24 pages
Total percentage	541.62 pages
Total vulgar (common) fractions	482.09 pages
Total compound denominate numbers	364.17 pages
Total decimals	228.56 pages
Total geometric forms	209.27 pages
Total powers and roots	166.34 pages
Measures (tables and their uses)	166.05 pages

All of these topics are treated in every one of the 16 books.

There is little evidence in Table VI of trends in the inclusion of certain topics in the arithmetics published between 1851 and 1880. Barter does not appear as a topic in any of the arithmetics put out after 1862 and mechanics not after 1872. On the other hand, construction workers', farmers', and painters' estimates; building association business; and bonds appear as topics for the first time in these texts in 1877. Other topics are found in books throughout the period studied, but either increase or decrease in popularity. Arithmetic (general aspects), for example, is given far more standard pages of space in the earlier books of the period than in the later ones, but it continues to be included as a topic in all of the books. Duodecimals, also, is considered important by the authors of the earlier texts, but many of the later texts drop the topic altogether. Partial payments, total practice, and miscellaneous written problems are other topics that lose favor to a certain extent during the period. Cases appear, also, in which a topic gains in popularity, and among these are found federal money, longitude and time, and total progression. An unusual situation occurs in the case of mechanics, which is found in only one of the 16 books but in this book, *Felter's New Practical Arithmetic*, it is given 31.51 standard pages, or 10.58 per cent of the entire space in the book.

Although Table VI shows the actual amount of space in terms of standard pages given to each topic, true comparisons between books cannot be made because the books are of different lengths and contain different numbers of topics. Thus a long book will naturally give more pages to each topic than will a short one which treats the same number of topics, but the relative emphasis given the subject by each of the books may be approximately the same.

Table VII therefore gives the same information as is found in Table VI, but it gives these data in the form of percentages of the total book, so that comparison of emphasis given different topics by the various books may be made. It is assumed that the per cent of space in a book given to a particular topic is indicative of the author's opinion relative to the degree of emphasis and the portion of time which should be given to the topic.

As has been pointed out, total fundamental processes in whole numbers is given the greatest amount of space (16.62 per cent) given to any of the topics. Only two other topics, total percentage and total vulgar (common) fractions, are given as much as 10 per cent of space each, while 21 topics, or more than half of the 38 major topics receive less than 1 per cent each when all books are combined.

TABLE VII. PER CENT OF 400-WORD PAGES GIVEN TO EACH TOPIC IN ARITHMETIC TEXTBOOKS FROM 1851 TO 1880

Topic	Dodd, James B., *Elementary and Practical Arithmetic*, 1854	Eaton, James S., *The Common School Arithmetic*, 1862	Colenso, Right Rev. J. W., *Arithmetic Designed For the Use of Schools*, 1864	Felter, S. A., *The Analysis of Written Arithmetic (Book Second)*, 1864	Dean, Philotus, *The Intermediate Arithmetic*, 1865	Greenleaf, Benjamin, *Introduction to the National Arithmetic*, 1867	Peabody, Selim H., *Felter's New Practical Arithmetic*, 1872	Peck, William G., *Complete Arithmetic, Theoretical and Practical*, 1874	French, John H., *First Lessons in Numbers*, 1874; and *Common School Arithmetic*, 1875	Hagar, D. B., *A Common School Arithmetic*, 1877	Meeutchen, S., and Sayre, G. M., *The New American Arithmetic, Part I*, 1877; and *The New American Practical Arithmetic*, 1877	Milne, William J., *The Practical Arithmetic on the Inductive Plan*, 1877	Raub, Albert N., *The Complete Arithmetic*, 1877	Ray, Joseph, *Ray's New Practical Arithmetic*, 1877; and *Ray's Elementary Arithmetic*, 1879	Baker, Andrew H., *Elementary Arithmetic*, 1878	Olney, Edward, *A Practical Arithmetic*, 1879	Subtotal	Total
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
Arithmetic symbols	.50	.52	.16	.51	.39	.36	.80	.75	.41	.50	.13	.59	.25	.48	.74	.36		.45
Arithmetic (general aspects)	1.10	.19	.05	3.28	.52	.09	2.34	.09	.25	.90	.06	.09	.18	.22	1.09	.05		.65
Total numeration	2.76	3.60	1.15	2.60	3.84	3.42	2.75	3.53	3.47	3.31	1.51	3.44	1.59	4.81	4.07	3.76		3.12
Numeration by words and Arabic symbols	2.76	3.07	1.02	2.26	3.26	2.95	2.46	3.21	3.45	3.05	1.51	2.84	1.42	4.26	4.07	3.05	2.79	
Numeration by Roman numerals	0	.54	.14	.35	.58	.48	.29	.33	.02	.27	0	.60	.16	.56	0	.71	.34	
Total fundamental processes in whole numbers	16.08	16.00	7.91	10.37	16.03	15.79	8.76	15.71	27.73	14.91	18.86	19.99	12.47	22.15	22.50	19.58		16.62
Addition and subtraction of whole numbers	.04	.39	0	.04	0	0	1.02	0	5.91	1.07	.61	0	0	.51	4.01	.16	.84	
Addition of whole numbers	2.25	2.24	.75	1.70	3.26	3.08	1.24	2.29	2.13	2.37	4.60	3.72	2.30	4.70	1.38	3.32	2.68	
Subtraction of whole numbers	1.87	1.59	.59	1.36	2.38	2.64	1.30	2.44	2.18	1.63	4.23	2.11	1.67	3.05	.94	2.90	2.12	
Multiplication and division of whole numbers	.06	0	0	.10	0	0	0	0	6.52	0	.47	0	0	0	3.62	0	.66	
Multiplication of whole numbers	3.74	3.42	1.77	2.11	2.83	4.03	2.10	3.42	3.27	3.20	5.06	4.31	2.44	4.48	5.10	4.96	3.45	
Division of whole numbers	8.11	8.36	4.81	5.06	7.55	6.04	3.10	7.57	7.73	6.63	3.89	9.83	6.07	9.28	7.44	8.24	6.86	
Total vulgar (common) fractions	11.29	11.06	12.56	19.54	10.93	10.22	11.37	10.39	10.62	9.46	10.26	12.31	13.85	11.86	13.92	13.03		11.94
Vulgar fractions (general)	3.03	6.77	7.49	11.32	5.44	4.64	5.23	4.30	6.92	5.01	5.63	6.00	7.74	5.93	1.19	6.68	6.12	
Cancellation of fractions	.17	0	0	.75	.73	.51	.46	1.15	0	.33	.47	.63	.46	.91	2.18	2.20	.61	

TABLE VII—CONTINUED

Topic	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Sub-total	Total
Aliquot parts	.80	.04	0	.04	.11	0	.05	.60	.59	.70	0	.77	0	.47	.20	1.20	.35	
Addition and subtraction of fractions	1.30	0	0	1.63	0	0	1.01	0	1.06	0	.47	0	0	.02	2.67	.39	.44	
Addition of fractions	.94	.67	1.04	1.33	.90	.68	.78	.82	0	.40	.65	.77	.82	.81	0	.43	.70	
Subtraction of fractions	1.52	.74	.91	.87	.86	1.27	.46	.87	0	.43	.42	.59	1.00	.87	0	.30	.70	
Multiplication and division of fractions	0	0	1.34	.10	0	0	.54	.82	0	0	0	0	0	0	2.38	0	.20	
Multiplication of fractions	1.70	1.72	.99	1.30	1.40	1.65	1.71	.79	.84	1.26	1.31	1.45	1.96	1.35	1.93	1.34	1.40	
Division of fractions	1.83	1.13	.80	2.20	1.48	1.46	1.14	1.04	1.21	1.34	1.32	2.10	1.87	1.49	3.37	.49	1.43	
Total decimals	9.08	5.53	7.67	9.68	4.87	4.26	3.84	5.17	6.24	4.49	4.65	5.60	3.74	5.94	3.22	6.05		5.66
Decimals (general)	2.92	3.61	6.36	3.74	3.13	2.05	2.36	2.63	3.15	2.84	3.05	2.91	1.99	3.38	1.38	2.98	3.07	
Addition of decimals	.90	.31	.14	1.65	.34	.32	0	.54	.46	.22	.26	.39	.25	.55	0	.16	.42	
Subtraction of decimals	.97	.26	.05	.82	.30	.65	0	.58	.48	.14	.26	.36	.18	.51	0	.30	.38	
Multiplication of decimals	1.87	.61	.32	1.82	.52	.63	.70	.79	.72	.62	.45	1.22	1.01	.60	1.09	1.25	.86	
Division of decimals	2.42	.74	.80	1.65	.58	.61	.78	.63	1.43	.66	.63	.71	.30	.90	.74	1.37	.93	
Duodecimals	1.87	1.50	.69	0	1.27	1.01	0	.82	0	.55	.11	0	.57	0	0	0		.50
Federal money	1.64	2.16	.35	1.61	3.50	2.62	1.22	2.71	1.95	2.75	4.53	.54	2.92	5.44	0	2.25		2.41
Measures (tables and their uses)	2.69	2.28	4.52	3.05	3.13	5.21	5.15	5.36	4.24	3.71	4.94	3.61	3.54	5.09	4.76	4.57		4.11
Total compound denominate numbers	7.93	9.73	12.41	6.56	9.56	11.06	9.97	9.44	8.20	7.17	6.10	6.89	7.14	12.05	10.06	10.32		9.02
Compound denominate numbers (general)	.52	1.83	2.54	1.82	.81	.89	3.82	.37	1.48	.57	.06	1.28	.82	2.55	1.03	4.57	1.65	
Addition of compound denominate numbers	.92	1.11	1.52	.02	1.27	1.31	.63	1.50	.77	.76	.48	.59	.82	1.38	1.99	.65	.92	
Subtraction of compound denominate numbers	1.20	1.15	1.23	.33	1.91	1.18	.36	1.34	1.06	.77	.56	.60	.78	1.50	1.29	1.64	1.04	
Multiplication of compound denominate numbers	.86	1.56	1.12	.42	.77	1.35	.15	1.13	.58	.71	.42	.26	.37	.96	1.19	.27	.72	
Division of compound denominate numbers	.82	.83	1.95	.54	1.29	1.12	1.20	1.96	1.06	.50	.69	.45	.09	.92	.90	.53	.91	
Reduction of compound denominate numbers	3.60	3.26	4.04	3.44	3.50	5.21	3.81	3.13	3.24	3.85	3.87	3.71	4.25	4.74	3.66	2.66	3.78	
Bills and accounts	0	.52	0	.23	.45	.59	0	.56	.20	1.03	1.32	1.18	1.03	.79	0	.87		.58
Exchange	0	1.70	1.68	2.61	1.74	1.43	1.09	1.98	.63	1.90	1.32	2.04	1.81	.91	2.53	1.81		1.52
Total geometric forms	7.78	3.09	2.27	4.92	4.27	5.37	7.96	6.39	2.66	7.63	8.41	4.69	6.02	3.74	1.93	4.77		5.18

TABLE VII—CONTINUED

Geometric forms (general)	4.10	1.70	.19	2.41	1.35	2.83	4.16	2.76	1.14	3.50	3.95	1.72	3.59	1.32	.90	1.34	2.34	
Areas of geometric forms	2.48	.78	1.20	1.50	1.72	1.61	2.62	1.28	1.05	1.23	1.73	2.04	1.19	1.86	1.03	1.95	1.60	
Volumes of geometric forms	1.20	.61	.88	1.00	1.20	.93	1.19	2.34	.47	2.89	2.73	.94	1.23	.57	0	1.48	1.24	
Total percentage	8.33	12.07	9.79	13.31	12.02	11.49	14.87	15.57	10.96	13.54	13.56	18.90	17.97	11.77	10.15	17.50		13.41
Percentage and its application (general)	4.10	1.42	.32	2.88	1.14	.61	2.94	2.40	2.97	2.81	2.58	3.59	3.49	2.04	.39	2.66	2.36	
Commission, brokerage, and insurance	.15	1.67	1.58	1.86	1.54	1.08	2.79	2.48	1.47	2.18	3.90	4.15	3.22	1.27	3.12	2.52	2.14	
Insurance	.06	.59	.64	.51	.66	.32	1.43	1.02	.58	.41	.27	1.45	1.09	.77	0	1.01	.72	
Profit and loss	0	1.79	.99	1.66	1.35	1.94	.80	1.23	.46	.65	.58	3.27	1.94	.37	0	1.20	1.20	
Discount	1.05	1.07	1.44	1.04	2.29	1.43	1.10	2.06	.42	1.63	.45	2.23	1.96	2.93	1.58	3.14	1.62	
Interest (general)	.34	.50	.94	.90	.21	.19	1.20	.04	.62	.87	1.10	1.01	.25	.31	2.62	.88	.67	
Simple interest	2.59	3.18	2.75	3.79	2.98	3.63	4.19	3.77	3.74	3.74	2.48	2.35	3.97	3.72	2.43	5.18	3.49	
Simple interest in annuities, etc.	0	.22	0	0	.26	.51	0	1.36	0	.70	.87	0	.66	0	0	0	.28	
Compound interest	.04	1.20	1.12	.68	1.09	1.12	.41	1.23	.71	.55	.35	.85	.92	.36	0	.92	.75	
Compound interest in annuities or pensions in arrears	0	.41	0	0	.51	.66	0	0	0	0	.97	0	.48	0	0	0	.19	
Partial payments	8.47	4.97	.83	6.03	4.44	3.91	4.23	4.57	3.71	3.52	3.15	3.15	2.87	1.38	2.13	3.12		3.76
Ratio	.57	.65	1.87	.48	.92	.51	1.54	.69	.37	.59	.84	.77	.41	1.08	7.09	.74		.90
Alligation	1.83	2.01	.43	1.62	1.99	1.65	.99	0	0	0	1.95	0	1.34	.34	4.36	0		.97
Proportion	4.02	5.09	12.13	2.24	3.71	3.10	4.49	4.40	1.51	2.83	1.90	2.47	4.18	1.88	0	2.43		3.50
Total partnership	1.28	1.33	0	1.01	1.20	1.37	.62	0	1.02	1.51	1.29	1.33	1.35	.52	0	.28		.94
Partnership (general)	0	.11	0	.36	.11	.11	.31	0	.18	.35	.08	.33	.09	.30	0	0	.17	
Simple fellowship or partnership	.99	0	0	.42	.39	.44	0	0	.54	.54	.48	.53	.52	0	0	0	.31	
Double fellowship or partnership	.30	1.22	0	.23	.69	.82	.31	0	.30	.63	.73	.47	.75	.22	0	.28	.46	
Longitude and time	0	.93	.61	0	1.44	0	.68	0	.65	.57	.63	.81	1.16	.48	1.24	1.05		.63
Total powers and roots	6.22	5.90	2.57	2.50	6.06	5.07	3.56	2.40	2.91	5.07	4.74	5.64	2.19	3.44	6.80	3.03		4.12
Powers and roots (general)	.48	0	1.31	.04	0	0	.23	0	0	0	1.00	0	.11	0	0	0	.12	
Involution or raising of powers	.28	.80	0	.28	1.07	.51	.91	.40	.29	.80	3.74	1.01	.14	.37	.25	.10	.53	
Evolution or extraction of roots	5.30	4.00	1.26	2.18	3.92	3.21	2.42	2.00	2.62	4.26	0	2.79	1.94	2.74	3.22	2.44	2.98	
Uses of square root	.08	.85	0	0	.73	1.25	0	0	0	0	0	1.21	0	.34	3.33	.32	.39	
Uses of cube root	.08	.26	0	0	.34	.09	0	0	0	0	0	.63	0	0	0	.17	.10	
Total practice	0	1.44	3.20	0	0	0	0	0	1.59	.82	0	0	0	0	0	0		.46
Practice (general)	0	.06	.05	0	0	0	0	0	.09	.06	0	0	0	0	0	0	.02	

TABLE VII—CONTINUED

Topic	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Sub-total	Total
Practice in finding total value of goods when price and quantity are given	0	1.15	3.15	0	0	0	0	0	.64	.76	0	0	0	0	0	0	.35	
Practice in finding price when quantity and total value are given	0	.11	0	0	0	0	0	0	.54	0	0	0	0	0	0	0	.05	
Practice in finding quantity that can be bought when price and total value are given	0	.13	0	0	0	0	0	0	.32	0	0	0	0	0	0	0	.04	
Barter	0	.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0		.01
Tare, trett, cloff, etc.	.12	.19	0	.10	.09	.13	.15	.23	.09	.10	0	.03	.14	.07	0	0		.09
Imports and exports	0	.63	0	.55	.60	.38	.78	.50	.38	.05	.48	.33	.52	.27	0	.77		.42
Total progression	0	1.67	0	0	1.35	2.77	0	1.79	1.86	1.50	2.31	1.28	2.70	1.05	2.48	.42		1.30
Arithmetic progression	0	.87	0	0	.92	1.46	0	1.10	.92	.79	1.19	.80	1.87	.57	2.48	.20	.76	
Geometric progression	0	.80	0	0	.43	1.31	0	.69	.95	.71	1.11	.48	.84	.48	0	.22	.54	
Permutations and combinations	0	.30	0	0	.67	.29	0	0	0	0	0	0	0	0	0	0		.08
Business forms	0	0	0	.03	.30	.29	.15	.25	.33	.19	.47	.47	.98	.07	0	0		.23
Bonds	0	0	0	0	0	0	0	0	0	0	0	0	.59	0	0	.82		.09
Building association business	0	0	0	0	0	0	0	0	0	0	.82	0	2.70	0	0	0		.22
Construction workers', farmers', and painters' estimates	0	0	0	0	0	0	0	0	0	1.33	0	0	0	0	0	.06		.10
Mechanics	0	0	0	0	0	0	10.58	0	0	0	0	0	0	0	0	0		.78
Bankruptcy	0	0	0	0	.69	0	.29	0	0	0	0	0	0	.13	0	.05		.08
Banking	0	.55	0	.70	0	.17	1.04	0	.47	.40	1.13	.03	.12	0	.94	0		.33
Taxes	.10	.94	0	.90	.60	.93	.80	.67	.48	1.10	.30	.92	.59	1.10	0	1.02		.71
Analysis	0	.70	1.90	0	1.91	2.56	0	2.52	.22	3.85	1.05	.83	1.90	0	0	0		1.10
Miscellaneous written problems	6.35	2.59	15.23	5.59	1.44	3.95	0	3.50	4.46	4.53	3.18	2.07	3.20	3.07	0	0		3.68
Other miscellaneous items	0	0	0	0	0	0	0	0	2.36	.20	0	0	0	0	0	1.26		.30
Total per cents	100.01	99.99	99.97	100.02	99.93	100.00	100.02	99.99	99.97	100.01	100.00	100.00	100.02	100.13	100.01	99.97		99.97

French's series gives a greater proportion of its space (27.73 per cent) to total fundamental processes as applied to whole numbers than do any of the other books. Baker's test gives 22.50 per cent of space to the topic while only three of the books give less than 10 per cent of space to this topic. There is no other major topic in the table to which any of the books gives more than 20 per cent of its space. A study of the emphasis given each of the fundamental processes when used with whole numbers shows that division is given almost twice as much space as any of the others, multiplication is next in importance, addition is next, and subtraction receives only about one tenth the emphasis given to division.

The range of space given to percentage is from 8.33 to 17.97 per cent. Of the 13.41 per cent of space given to percentage by all books combined, 3.49 per cent is given to simple interest; 2.36 per cent to percentage and its application; 2.14 per cent to commission, brokerage, and insurance; 1.62 per cent to discount; and 1.20 per cent to profit and loss. The other subtopics under percentage are given a very small amount of space.

The range of percentage of space given to common fractions is from 9.46 to 19.54 per cent. Three of the books include no treatment of cancellation and four give no treatment to aliquot parts; only .61 per cent of the space in all books combined is given to the former topic and only .35 per cent to the latter. Nearly twice as much space is given to both multiplication and division of common fractions as is given to addition and subtraction.

The range in emphasis given to the treatment of decimals is from 3.22 to 9.68 per cent. Multiplication and division are emphasized much more than addition and subtraction in this field also.

Very little evidence of trends is found in these texts, as, in general, the authors seem to be in agreement as to the topics that should be included in the arithmetics of the day.

Space given to each type of content.—The same scheme of analysis has been used in this period of the study as was used in the two earlier parts. In addition to the analysis of the topics presented in the arithmetics of the period, an analysis has also been made of the type of content included. Table VIII shows the number of standard 400-word pages given to each type of content in the books published in the third period of this investigation—1851 to 1880.

The topic reduction, shown on Table VIII, includes all phases of reduction whether applied to common fractions, decimals, or denominate numbers. It also overlaps such phases as are mentioned in the first and last topics of the table. Similarly, questions, the last topic of Table VIII, overlaps many other aspects mentioned in the table. Addition, subtraction, multiplication, and division do not overlap each other, but they do contain materials found in the first eight types of content; that is, for example, addition as a topic includes all phases of addition, whether rules, definitions, examples, tables, or problems.

As has been explained in the first two parts of this study, there is considerable overlapping of pages in this table. As a consequence, the total number of standard pages in each column exceeds the actual

TABLE VIII. NUMBER OF 400-WORD PAGES GIVEN TO EACH TYPE OF CONTENT IN ARITHMETIC TEXTBOOKS FROM 1851 TO 1880

Type of Content	Dodd, James B., *Elementary and Practical Arithmetic*, 1854	Eaton, James S., *The Common School Arithmetic*, 1862	Colenso, Right Rev. J. W., *Arithmetic Designed For the Use of Schools*, 1864	Felter, S. A., *The Analysis of Written Arithmetic (Book Second)*, 1864	Dean, Philotus, *The Intermediate Arithmetic*, 1865	Greenleaf, Benjamin, *Introduction to the National Arithmetic*, 1867	Peabody, Selim H., *Felter's New Practical Arithmetic*, 1872	Peck, William G., *Complete Arithmetic, Theoretical and Practical*, 1874	French, John H., *First Lessons in Numbers*, 1874; and *Common School Arithmetic*, 1875	Hagar, D. B., *A Common School Arithmetic*, 1877	Mecutchen, S., and Sayre, G. M., *The New American Arithmetic, Part I*, 1877; and *The New American Practical Arithmetic*, 1877	Milne, William J., *Arithmetic on the Inductive Plan*, 1877	Raub, Albert N., *The Complete Arithmetic*, 1877	Ray, Joseph, *Ray's New Practical Arithmetic*, 1877; and *Ray's Elementary Arithmetic*, 1879	Baker, Andrew H., *Elementary Arithmetic*, 1878	Olney, Edward, *A Practical Arithmetic*, 1879	Total
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Definitions and explanations	19.85	23.79	18.76	19.78	29.26	27.12	46.32	23.84	27.77	35.22	22.89	25.72	28.88	31.67	7.34	23.34	411.55
Tables and explanations	7.01	12.63	9.64	13.54	15.30	22.10	16.12	13.29	21.69	13.11	21.35	13.90	11.87	21.84	5.67	13.88	232.94
Rules and explanations	20.94	38.90	21.29	16.22	36.01	37.26	20.67	23.99	42.54	25.60	17.97	20.42	20.10	31.29	5.00	29.16	407.36
Examples and explanations	45.32	74.49	70.86	78.15	58.19	67.76	77.29	33.84	68.38	59.92	39.24	46.43	43.20	63.41	34.71	51.72	912.91
Drill problems without answers	4.33	27.50	23.81	41.31	12.73	16.07	39.78	15.49	25.58	31.28	53.68	66.47	21.58	31.92	1.99	40.46	453.98
Drill problems with answers	17.25	15.11	2.30	.88	44.08	33.99	2.23	26.74	9.86	14.45	1.02	.75	25.92	44.03	3.16	8.56	250.33
Written problems without answers	2.59	35.20	55.77	57.68	4.47	7.95	51.06	6.23	72.25	31.28	73.96	84.04	30.31	11.36	4.36	63.60	592.11
Written problems with answers	67.80	20.91	2.52	.57	40.99	63.65	5.13	35.53	48.56	41.80	1.38	3.05	70.55	71.54	2.09	10.89	486.96
Reduction	13.16	25.74	20.14	24.56	22.42	26.50	24.15	16.52	21.13	22.55	23.65	25.97	27.21	34.78	4.47	19.82	352.77
Combined addition and subtraction	2.67	3.95	.92	5.01	0	1.52	6.05	0	24.05	3.54	2.57	0	0	1.83	5.21	2.42	59.74
Combined multiplication and division	.12	0	3.27	.54	.57	1.47	2.13	1.76	23.27	0	1.11	0	0	0	4.32	1.76	40.32
Combined addition	9.80	11.99	7.40	12.58	15.77	17.87	9.92	9.93	11.49	9.85	15.33	15.24	12.24	26.36	2.38	12.41	200.56
Combined subtraction	10.89	10.43	5.97	9.33	14.44	17.98	6.39	10.15	13.12	8.55	14.04	10.27	10.72	21.04	1.67	16.46	181.45
Combined multiplication	18.23	22.13	10.38	15.41	17.29	24.18	13.94	12.89	18.96	17.14	18.36	20.17	16.45	26.89	6.74	20.76	279.92
Combined division	26.12	30.37	17.96	26.47	30.83	32.02	18.63	21.65	39.96	26.89	16.99	38.12	26.29	45.74	8.93	29.44	436.41
Questions	1.86	7.17	4.07	23.41	6.60	13.76	21.44	4.58	.36	14.23	.23	8.22	.05	4.33	0	2.62	112.93

number of standard pages in the book. Since the column totals therefore are meaningless, they have been omitted.

Thirteen of the 16 books include all 16 types of content and all of the others include at least 14 of the types. Of the three topics not included in all of the arithmetics, questions appear in 15 of the books, combined addition and subtraction in 12 of them, and combined multiplication and division in only 11 of them.

In the first period studied in this investigation, there seems to have been no question in the minds of the authors as to the desirability of including the answers to problems. By 1851, however, there is evidence of a division of opinion on this subject. Nine of the 16 books include more pages of written problems without answers than of those with answers, while seven give more space to written problems with answers; also, nine of the texts give more emphasis to drill problems without answers than to those with answers. It seems, that almost all the authors were very definite in their approval or disapproval of including answers, as there is a wide difference in the amount of space given to the two types of problems. In Dodd's *Elementary and Practical Arithmetic*, for example, only 2.59 standard pages are given to written problems without answers, while 67.80 pages are given to written problems with answers. On the other hand, Milne's *The Practical Arithmetic on the Inductive Plan* gives 84.04 pages to written problems without answers and only 3.05 pages to written problems with answers. Extreme differences similar to these are found in a number of the other books also. However, the differences between these two groups is much greater, as a rule, in the books which stress problems without answers.

In Table IX the data given in Table VIII are presented as percentages. Because of the type of information, as explained in connection with Table VIII, there is a certain amount of overlapping among the various types of content, and for this reason the percentages add to more than 100. However, the relative emphasis given to each type of content is shown by these percentages, since each percentage is based on the total number of pages in the book rather than on the total number of pages listed as given to the various types of content.

In all 16 books combined, examples and explanations receive 22.61 per cent of space, far more than any other one type of content. However, if the written problems without answers and those with answers (which are the next two types with respect to space allotted) are combined, written problems head the list, with 26.72 per cent of space. Drill problems follow next with 17.44 per cent when those with and without answers are combined. No other types of content are given as much as 11 per cent of space, although division, definitions and explanations, and rules and explanations are given almost this much space. Combined multiplication and division is given only 1 per cent of space and combined addition and subtraction 1.48 per cent.

The highest percentage of space given by any of the books to any one type of content is 48.55, given by Baker, in his *Elementary Arithmetic*, to examples and explanations. Mecutchen and Sayre give only 12.74 per cent of space to this type of content, but all books

TABLE IX. PER CENT OF 400-WORD PAGES GIVEN TO EACH TYPE OF CONTENT IN ARITHMETIC TEXTBOOKS FROM 1851 TO 1880

Type of Content	Dodd, James B., *Elementary and Practical Arithmetic*, 1854	Eaton, James S., *The Common School Arithmetic*, 1862	Colenso, Right Rev. J. W., *Arithmetic Designed For the Use of Schools*, 1864	Felter, S. A., *The Analysis of Written Arithmetic (Book Second)*, 1864	Dean, Philotus, *The Intermediate Arithmetic*, 1865	Greenleaf, Benjamin, *Introduction to the National Arithmetic*, 1867	Peabody, Selim H., *Felter's New Practical Arithmetic*, 1872	Peck, William G., *Complete Arithmetic, Theoretical and Practical*, 1874	French, John H., *First Lessons in Numbers*, 1874; and *Common School Arithmetic*, 1875	Hagar, D. B., *A Common School Arithmetic*, 1877	Meeutchen, S., and Sayre, G. M., *The New American Arithmetic, Part I*, 1877; and *The New American Practical Arithmetic*, 1877	Milne, William J., *The Practical Arithmetic on the Inductive Plan*, 1877	Raub, Albert N., *The Complete Arithmetic*, 1877	Ray, Joseph, *Ray's New Practical Arithmetic*, 1877; and *Ray's Elementary Arithmetic*, 1879	Baker, Andrew H., *Elementary Arithmetic*, 1878	Olney, Edward, *A Practical Arithmetic*, 1879	Total
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Definitions and explanations	10.30	9.03	8.74	7.47	11.55	9.14	15.56	12.50	8.05	12.43	7.43	9.29	11.12	9.59	10.27	8.98	10.19
Tables and explanations	3.64	4.79	4.49	5.12	6.04	7.45	5.41	6.97	6.29	4.63	6.93	5.02	4.57	6.62	7.93	5.34	5.77
Rules and explanations	10.87	14.76	9.92	6.13	14.21	12.56	6.94	12.58	12.33	9.03	5.83	7.38	7.74	9.48	6.99	11.22	10.09
Examples and explanations	23.53	28.26	33.01	29.53	22.96	22.83	25.96	17.75	19.83	21.15	12.74	16.78	16.64	19.21	48.55	19.90	22.61
Drill problems without answers	2.25	10.43	11.09	15.61	5.02	5.41	13.36	8.12	7.42	11.04	17.43	24.02	8.31	9.67	2.78	15.57	11.24
Drill problems with answers	8.95	5.73	1.07	.33	17.40	11.45	.75	14.02	2.86	5.10	.33	.27	9.98	13.34	4.42	3.29	6.20
Written problems without answers	1.34	13.36	25.98	21.79	1.76	2.68	17.15	3.27	20.95	11.04	24.01	30.36	11.67	3.34	6.10	24.47	14.66
Written problems with answers	35.20	7.93	1.17	.22	16.18	21.45	1.72	18.63	14.08	14.75	.45	1.10	27.17	21.67	2.92	4.19	12.06
Reduction	6.83	9.77	9.38	9.28	8.85	8.93	8.11	8.66	6.13	7.96	7.68	9.38	10.48	10.54	6.25	7.63	8.74
Combined addition and subtraction	1.39	1.50	.43	1.89	0	.51	2.03	0	6.97	1.25	.83	0	0	.55	7.29	.93	1.48
Combined multiplication and division	.06	0	1.52	.20	.22	.50	.72	.92	6.75	0	.36	0	0	0	6.04	.68	1.00
Combined addition	5.09	4.55	3.45	4.75	6.22	6.02	3.33	5.21	3.33	3.48	4.98	5.51	4.71	7.99	3.33	4.77	4.97
Combined subtraction	5.65	3.96	2.78	3.52	5.70	6.06	2.15	5.32	3.80	3.02	4.56	3.71	4.13	6.37	2.34	6.33	4.49
Combined multiplication	9.46	8.40	4.84	5.82	6.82	8.15	4.68	6.76	5.50	6.05	5.96	7.29	6.34	8.15	9.43	7.99	6.93
Combined division	13.56	11.52	8.37	10.00	12.17	10.79	6.26	11.35	11.59	9.49	5.52	13.77	10.12	13.86	12.49	11.33	10.81
Questions	.97	2.72	1.90	8.84	2.60	4.64	7.20	2.40	.10	5.02	.07	2.97	.02	1.31	0	1.01	2.80

combined give 22.61 per cent. Dodd gives 35.20 per cent of space to written problems with answers, Colenso gives 33.01 per cent to examples and explanations, and Milne gives 30.36 per cent to written problems without answers, but no other book gives as much as 30 per cent of its space to any one type of content.

The four fundamentals receive nearly one third of the space in the 16 books combined. Subtraction is given the least emphasis of any of the fundamental processes and addition is next, 4.49 and 4.97 per cent, respectively. Multiplication receives 6.93 per cent of space and division is given 10.81 per cent, approximately as much as the total given to addition, subtraction, and addition and subtraction combined. The problems classified as addition, subtraction, multiplication, or division in Tables VIII and IX are not included under other headings in those tables. Since all arithmetic problems involve at least one of these processes, it is evident that pupils receive far more practice in this type of content than is shown by these figures.

There is almost no evidence of trends toward including or excluding certain types of content from the texts studied. There seems to be a somewhat higher percentage of tables and their explanations and of drill and written problems and a smaller percentage of questions as the period progresses, but even here the trend is so slight as to be uncertain.

Analysis of problem subjects.—In addition to the quantitative analysis of topics and types of content found in the arithmetics published between 1851 and 1880, an analysis has been made of the concrete subjects of written problems in each of the books. This third phase of the analysis also follows the pattern of that used in studying the texts in the two earlier periods of this investigation. The problem subjects with their frequencies have been classified under the same major headings and divisions as those used in the first two parts of the study, that is, economic, socio-economic, sociological, and miscellaneous.

The groupings, especially under economic, socio-economic, and sociological divisions, are to a certain extent subjective; but, as has been explained in the discussion of the first unit of this study, accepted definitions of economics and of sociology have been used as guides in making the classifications. The final groupings of problem subjects, together with the frequency of each in each book, are shown in Table X.

Economic and sociological influences are so interrelated that it is frequently difficult to determine a definite placement for problem subjects under one or the other division. The research worker has been compelled to rely on his own judgment, aided by definitions of the terms and by his observation of the general context of the problems in which the subjects were found, in determining proper placement. In so far as possible, problem subjects which seemed definitely to be inclined more toward the economic were grouped under economic subjects; those which seemed to lean more toward the sociological were classified under sociological subjects; those which seemed definitely on the border line were classified under socio-economic sub-

TABLE X. FREQUENCY OF MENTION OF PROBLEM SUBJECTS IN ARITHMETIC TEXTBOOKS FROM 1851 TO 1880

Problem Subjects	Dodd, James B., *Elementary and Practical Arithmetic*, 1854	Eaton, James S., *The Common School Arithmetic*, 1862	Colenso, Right Rev. J. W., *Arithmetic Designed For the Use of Schools*, 1864	Felter, S. A., *The Analysis of Written Arithmetic (Book Second)*, 1864	Dean, Philotus, *The Intermediate Arithmetic*, 1865	Greenleaf, Benjamin, *Introduction to the National Arithmetic*, 1867	Peabody, Selim H., *Felter's New Practical Arithmetic*, 1872	Peck, William G., *Complete Arithmetic, Theoretical and Practical*, 1874	French, John H., *First Lessons in Numbers*, 1874; and *Common School Arithmetic*, 1875	Hagar, D. B., *A Common School Arithmetic*, 1877	Mecutchen, S., and Sayre, G. M., *The New American Arithmetic, Part I*, 1877; and *The New American Practical Arithmetic*, 1877	Milne, William J., *The Practical Arithmetic on the Inductive Plan*, 1877	Raub, Albert N., *The Complete Arithmetic*, 1877	Ray, Joseph, *Ray's New Practical Arithmetic*, 1877; and *Ray's Elementary Arithmetic*, 1879	Baker, Andrew H., *Elementary Arithmetic*, 1878	Olney, Edward, *A Practical Arithmetic*, 1879	Total
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Economic Subjects																	
Acreage	0	47	16	0	7	55	2	0	1	32	27	10	0	37	15	11	260
Area content	8	17	11	10	12	3	8	3	14	10	0	12	7	10	2	13	140
Bankruptcy	1	2	9	0	0	2	0	1	0	3	3	3	0	0	0	6	30
Banks and banking	9	3	0	18	14	1	5	4	20	4	9	25	26	8	0	14	160
Barter	0	0	0	9	0	0	0	12	1	0	0	0	14	0	0	0	36
Bills of goods	0	0	1	0	0	0	3	0	0	0	0	13	0	0	0	0	17
Bonds	0	0	1	5	6	0	0	1	5	1	6	19	0	0	1	19	64
Bricks	0	4	2	0	6	3	5	1	22	13	6	9	8	4	0	5	88
Brokerage and commission	0	6	0	26	0	0	0	0	0	0	0	15	1	0	1	4	53
Building and construction work	30	43	32	60	88	39	83	34	156	78	72	100	62	89	16	95	1,077
Business transactions	5	2	1	12	2	0	2	9	6	0	3	5	4	0	0	0	51
Business	30	4	1	17	3	4	2	11	6	3	2	18	7	9	2	11	130
Clocks	0	0	0	0	4	2	1	2	4	1	0	2	4	2	0	0	22
Cloth and clothing	129	75	22	108	45	86	70	94	139	68	116	142	202	142	30	145	1,613
Distance	0	0	0	0	3	0	0	1	1	0	0	3	9	0	1	3	21
Estate and property	30	4	9	14	19	4	11	2	21	6	10	26	21	9	2	14	202
Exchange	0	0	1	2	0	0	0	0	0	0	0	7	0	0	0	0	10
Expenses	1	0	1	2	9	0	1	2	4	0	0	12	0	0	0	5	37
Farms	5	15	2	28	2	14	8	11	30	16	17	32	42	17	5	17	261
Fences and fencing	7	3	1	5	2	1	3	0	54	1	9	3	7	3	0	8	107

TABLE X—CONTINUED

Fields	23	3	1	8	1	5	5	4	13	11	14	13	19	20	2	7	149
Foods and farm products	251	157	86	279	125	268	178	174	509	274	357	254	377	391	58	180	3,918
Fuel	14	10	1	6	15	9	13	9	37	22	29	13	29	8	0	11	226
Harnesses	1	0	0	0	1	3	1	0	3	1	0	2	2	2	1	2	19
Houses and lots	6	1	0	6	4	15	4	1	33	1	0	2	17	4	0	7	101
Household articles	22	3	11	16	13	15	27	12	176	6	36	23	46	26	2	22	456
Income	1	4	0	0	7	0	1	0	8	5	18	22	0	9	0	7	82
Indebtedness	18	8	8	10	22	2	4	3	29	2	7	16	1	6	0	12	148
Industry, types of	15	0	2	11	3	3	5	5	17	0	5	6	4	4	2	3	85
Insurance	0	9	0	19	30	0	0	21	22	9	4	36	0	13	0	21	184
Labor	0	0	0	14	1	1	0	19	16	0	0	1	26	0	0	0	78
Land	81	0	0	30	6	4	9	13	15	2	4	11	40	8	0	7	230
Latitude and longitude	0	9	0	0	35	0	5	1	15	0	0	21	0	12	2	25	125
Legacy and inheritance	0	3	3	3	1	4	0	10	0	7	2	4	2	0	0	0	39
Machinery	0	0	1	0	0	4	11	1	5	0	1	0	0	1	0	1	25
Meadows	4	0	0	1	0	0	1	2	3	0	1	0	0	0	0	1	13
Merchandise	0	1	2	11	1	3	1	5	9	2	5	1	6	0	0	0	47
Metal articles	9	15	8	11	12	13	20	10	90	17	18	18	23	13	3	13	293
Metals	10	10	20	22	22	20	11	14	39	10	35	12	36	10	0	14	285
Mills	1	1	0	1	1	3	1	0	12	4	2	11	3	1	0	0	41
Mints and coinage	0	0	1	0	0	0	0	0	5	0	0	0	0	0	0	0	6
Notes	0	0	0	29	38	0	13	0	50	0	0	47	0	4	0	63	244
Occupations	238	68	42	145	37	48	64	95	446	84	154	210	275	154	17	119	2,196
Orchards	1	2	0	0	0	3	0	3	3	3	0	4	3	3	0	4	29
Paint	0	0	0	0	1	0	3	0	1	3	0	0	0	1	0	0	9
Paper	1	0	3	2	1	4	0	0	19	0	14	6	9	14	0	1	74
Pastures	3	1	4	3	1	1	1	2	4	3	2	6	6	2	2	4	45
Pensions	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3
Rations and provisions	7	2	3	0	4	0	1	1	2	2	0	1	0	1	0	0	24
Rents	2	0	12	4	1	4	3	4	16	4	11	2	24	2	0	3	92
Saving	0	0	2	1	4	0	0	1	0	2	2	1	0	0	0	0	13
Shipping and seamen	1	2	0	0	1	1	0	0	1	0	0	0	0	0	0	0	6
Stocks and shares	2	16	7	30	27	10	18	17	10	5	16	48	63	17	0	13	299
Stores	1	0	0	1	3	0	2	2	4	1	2	7	26	1	0	3	53
Taxes	4	10	13	9	21	11	15	9	27	9	17	17	23	23	0	24	232
Transportation	42	32	23	42	18	32	47	41	151	39	52	37	53	40	2	48	700
Wheels	0	3	4	1	2	2	12	0	9	0	3	2	1	5	0	2	46
Wood and timber	6	32	5	45	16	47	41	33	79	28	35	36	36	19	1	30	489
Work	6	9	6	4	8	4	5	5	42	3	7	9	12	10	1	11	142

TABLE X—CONTINUED

Problem Subjects	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Total
Socio-Economic Subjects																	
Charities	2	0	0	0	3	0	0	3	0	0	0	6	0	0	0	2	16
Education	12	13	5	14	11	8	20	5	103	9	75	54	50	55	3	23	460
Military references	14	20	11	8	13	7	5	9	53	6	8	13	2	16	0	3	188
Newspapers and magazines	0	0	1	0	0	0	0	0	3	0	2	2	1	3	0	0	12
Post office and postage	0	0	1	0	0	0	0	0	0	1	0	1	1	5	0	1	10
Telegrams	0	1	0	0	2	0	0	1	6	0	3	0	2	0	0	5	20
Travel	24	20	10	5	4	25	2	15	24	20	17	16	19	27	7	26	261
Wages (salaries)	6	6	7	14	6	4	4	4	22	12	4	25	43	6	1	7	171
Sociological Subjects																	
Alcoholic beverages	27	14	14	20	11	10	19	4	7	7	22	4	16	25	4	4	208
Bible and religion	0	0	3	0	0	5	0	0	0	1	1	0	0	2	0	0	12
Candles and candlesticks	2	0	0	1	0	0	0	0	4	0	1	0	0	0	0	0	8
Cisterns and pipes	8	2	9	1	2	7	6	0	6	5	7	5	1	5	0	5	69
Family and family relations	4	4	1	0	1	2	0	13	48	1	8	3	13	6	0	0	104
Government and courts	2	0	0	1	1	0	0	1	3	6	2	0	2	2	0	2	22
Government units	10	0	2	1	3	4	0	3	5	3	4	5	1	5	0	14	60
Health	0	0	2	0	0	1	0	0	1	0	4	1	0	2	0	0	11
Holidays	0	0	0	0	1	1	0	0	6	0	2	2	1	3	0	3	20
Inns or hotels	0	0	3	0	0	0	0	0	6	0	1	0	2	3	0	0	15
Medicines	1	0	1	5	8	4	6	1	9	3	12	4	2	2	0	4	62
Moral issues	0	0	2	1	0	3	0	1	0	0	2	0	0	0	0	0	9
Population	4	16	2	0	2	6	0	5	0	7	1	0	3	4	0	0	50
Recreation	0	1	2	2	2	2	1	3	28	3	17	6	0	13	0	6	86
Religion or church societies	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	4
Miscellaneous Subjects																	
Age determination	4	1	0	0	8	5	0	0	9	12	2	10	24	3	0	7	85
Animals	54	66	24	65	22	30	40	35	174	54	70	132	159	97	29	64	1,115
Balls	0	1	0	1	3	0	1	0	11	2	2	2	3	1	0	2	29
Boxes	3	5	0	0	0	4	4	2	1	4	2	2	0	2	0	0	29
Climate	1	0	1	1	5	1	7	3	4	3	4	2	1	3	0	5	41
Earth's size and motion	4	5	5	2	2	3	5	0	4	4	12	3	0	7	0	3	59
Flowers	0	0	0	0	0	0	0	0	17	0	1	4	5	0	0	1	28
Geographical references	3	4	2	11	2	6	0	12	15	5	5	3	0	3	0	4	75
Historical references	1	18	3	0	6	3	0	0	8	8	6	3	1	28	0	15	100
Literature	0	0	0	0	1	0	0	1	0	1	5	1	0	2	1	1	13

TABLE X—CONTINUED

Planetary system	4	2	3	0	7	10	1	1	2	3	0	0	0	2	0	3	38
Shadows of a pole	0	5	1	0	1	1	0	0	2	0	2	3	0	1	2	2	20
Stones	1	3	1	7	4	2	9	0	15	4	13	4	8	9	0	0	80
Time	0	0	0	1	13	0	10	0	7	2	4	20	31	1	1	30	120
Travel of light	1	2	2	0	3	2	1	1	2	2	1	0	1	3	1	1	23
Trees	1	9	3	2	0	4	0	5	28	6	8	7	9	12	0	9	103
Other miscellaneous articles	57	26	39	58	50	53	91	28	313	62	76	110	63	58	15	83	1,182
Total economic subjects	1,025	638	378	1,080	705	753	726	705	2,405	796	1,133	1,355	1,576	1,154	168	1,028	15,625
Total socio-economic subjects	58	60	35	41	39	44	31	37	211	48	109	117	118	112	11	67	1,138
Total sociological subjects	58	37	41	32	32	46	32	31	126	36	84	30	41	72	4	38	740
Total miscellaneous subjects	134	147	84	148	127	124	169	88	612	172	213	306	305	232	49	230	3,140
Grand total	1,275	882	538	1,301	903	967	958	861	3,354	1,052	1,539	1,808	2,040	1,570	232	1,363	20,643
Number of standard pages of written problems	70.39	56.11	58.29	58.25	45.46	71.60	56.19	41.76	120.81	73.08	75.34	87.09	100.86	82.90	6.45	74.49	1,079.07
Average number of times each economic, socio-economic, or sociological subject is mentioned on each standard page of written problems	16.2	13.1	7.8	19.8	17.8	11.8	14.0	18.5	22.7	12.0	17.6	17.2	17.2	20.9	28.4	15.2	16.2

jects; and those which seemed to have no definite economic or sociological implications were grouped in the miscellaneous division.

As many as five problem subjects are mentioned at least a thousand times each, food and farm products being mentioned nearly four thousand times. These include food and farm products (3,918), occupations (2,196), cloth and clothing (1,613), animals (1,115), and buildings and construction work (1,077).

Economic subjects comprise about 75 per cent of all subjects included in the problems. Felter's *Analysis of Written Arithmetic* contains the largest percentage of economic subjects (83) and Colenso's text contains the smallest percentage (70). The percentage of socio-economic and sociological subjects is small in all books, with 11 of the 16 books including only 6 to 9 per cent of subjects of this nature.

There seems to be little relationship between the total number of pages of written problems and the number of problem subjects in each book. For example, the book which contains the fewest mentions of foods and farm products, occupations, and buildings and construction work also has the fewest number of pages of written problems; while the book which includes the fewest mentions of cloth and clothing is seventh from the shortest in amount of space given to written problems and the one that mentions animals most seldom is next to the shortest. Also, the book which contains the most mentions of foods and farm products, occupations, buildings and construction work, and animals is the longest in number of pages of written problems and the one that mentions cloth and clothing most frequently is next to longest.

Of those topics classified as economic, a few of the most important, in descending order of their frequencies, are:

Foods and farm products	Wood and timber	Acreage
Occupations	Household articles	Notes
Cloth and clothing	Stocks and shares	Taxes
Buildings and construction work	Metal articles	Land
Transportation	Metals	Fuel
	Farms	Estate and property

No other economic problem subject is mentioned more than 200 times in all books combined. Several of the topics which have low total frequencies occur a few times in each of the books, however; while some of the high frequency topics are not found in every book.

The socio-economic subjects which are mentioned more than 200 times each in these books are education and travel, and of the sociological subjects, alcoholic beverages is the only one mentioned more than 200 times. Not one of the sociological subjects is found included in all 16 of the books analyzed for this period.

Of the miscellaneous subjects, animals is the only subject mentioned more than 200 times and it is included as many as 1,115 times. No other single topic of this group is mentioned in all books.

Of the entire 20,643 problem subjects gleaned from 1,079.07 standard pages of written problems in all books combined, 15,625, or nearly three fourths, of them have been classified as economic sub-

jects. Of the remaining one fourth, only 1,138 have been classified as socio-economic, 740 as purely sociological, and 3,140 as miscellaneous.

It is also interesting to note the frequency with which economic, socio-economic, and sociological subjects combined are mentioned on the average per standard page of written problems. The range is from a little less than seven times per page in one book to nearly 30 times per page in another. The average frequency of mention per page in all books combined is 16.2. Thus it seems that, in solving problems in these books, the pupil's attention is repeatedly centered on practical subjects or life situations.

Detailed subjects.—Further presentation of some of the detailed subjects included within certain of the groupings shows more specifically the direct relationship of problem subjects to economic and sociological situations characteristic of the times.

A variety of problem subjects is listed under food and farm products. Some of these farm products are not foods, others are foods for animals but not for man. Also, some of the foods included are not derived from the farm. However, there is so much interrelation between foods and farm products that it seemed advisable to include them in the same list. The wide scope of these problem subjects indicates to some extent that the authors attempted to base their problems on practical everyday topics. The less common foods and farm products mentioned in these 16 books are as follows:

acorns
barley
broom corn
buckwheat flour
chestnuts
chiccory
cod fish
dry fish
flax seed
ginger root
hemp
herring
penny loaf
tallow

One of the most interesting of the groupings is that of occupations. The following list of the various types of workers includes the more unusual types found in the texts:

apprentice
army contractor
basket maker
blacksmith
boatman
book seller
brewer
brick-maker
cap maker
car man
carriage maker
carter
charcoal man
chorister
conveyancer
cooper
corn factor
cotton factor
cutter
dealer in crockery
draper
drayman
drover
fencer
footman
founderer
fowler
fruiterer
glazier
grazier
granger
harness maker
hatter
hostler
iron monger
joiner
journeyman
livery man
livery stable keeper
map agent
market man
merchant tailor
miller
paver
pail maker
pointer
paper maker
phonographic reporter
potter
reaper
salter
sea captain
seedman
sergeant at arms
sexton
shepherd
skipper
stevedore
steward
tanner
taverner
testor
tin peddler
tin-smith
tobacconist
town agent
truckman
truck maker
vinter
wagon maker
warder
watch maker
weaver

Apparently, different names were sometimes used for the same kind of worker, such as agriculturist, granger, and farmer; corn factor and corn merchant; and cotton broker and cotton factor. A number of the types, such as basket maker, cap maker, and wagon maker, are more or less uncommon today, but they no doubt were of much greater importance during the times in which these books were written. Other types of workers mentioned, such as charcoal man, carriage maker, carter, livery man, livery stable keeper, drover, glazier, hostler, salter, and warder, are rarely used today. Changes in industry, travel, and transportation have brought about many changes in vocations. It is surprising to find that several of the workers mentioned, such as cotton planter, iron monger, miner, skipper, and tobacco grower, are characteristic of only certain sections of the country. Outside of the sections in which these workers were employed, probably not much was known of such occupations even during the period in which these 16 books were written.

The various kinds of cloth and clothing and related articles mentioned in these books are also extremely interesting. Most of the types mentioned are still found in current dry-goods and clothing trade and are thus not peculiarly characteristic of the period in which these books were written though they were apparently common articles of that day. Some of the items, such as bombazine, camblet, delaine, drilling, sarcenet, and silk mantillas are rare in present-day transactions and usage, though no doubt they were quite common three quarters of a century ago. The following is a list of the less common items of cloth and clothing mentioned in written problems in the 16 books analyzed for this unit:

alpaca
basting cotton
beaver skin
bombazine
bonnet wire
bonnet
braid
breast pin
brocade
brogan
buffalo robe
calf boots
calf skin
camblet
cambric handkerchief
cassimere
coach lace
cotton bat
cotton hose
cravat
delaine
drilling
drugget
edging
empress cloth
fur cap
fur gloves
gaiters
gold thread
hip boots
Irish cloth
ladies' boots
ladies' kid shoes
mackinaw blanket
merino
merrimac print
muff
oversack
overshoes
pantaloons
paper cap
paper collar
petersham
riding habit
rubber buttons
rubber shoes
sarcenet
satinet
sewing silk
shawl
shoe pegs
silk grenadine
silk mantilla
silk velvet
sole leather
strap
suit fur
surtout
tope
twist
vest

Of the different animals mentioned as problem subjects, horses, cows, sheep, oxen, and cattle are the most frequently used. The majority of animals mentioned are those found on the farm. Thus they were within the range of the common experiences of pupils. The few that are perhaps not as commonly mentioned today are:

bantam	greyhound	prairie fowl
deer	ox	wild beast

A number of references are also made to buildings and construction work. These items found in the written problems of the texts analyzed give us some idea of the nature and types of construction and the terms applied to the materials used. The items all seem to have been common at the time the books were written and with only a few exceptions are still common today. A few which may be less familiar to children today follow:

carriage house	ridge pole
castle	scantling
clapboard	slate roof
mercantile building	stable
plank road and walk	stairs and stair rod
plates of building	stone sleeper
public hall and building	tier of windows

Several metals and alloys are also used as problem subjects, the chief of which are gold, iron, and silver. The complete list of such mentions is given, as it probably represents the chief metals, ores, and alloys known as useful during the period.

brass	gun metal	pig iron
cast iron	iron	quicksilver
cast steel	iron ore	sheet iron
copper	lead	sheet tin
copper ore	manganese	silver
gold	metal	steel
gold dust	nickel	tin
gold quartz	ore	zinc

The metal articles mentioned that are more or less unusual today include the following:

adze	gold wedge	nail rod
anchor	gold wire	potash kettle
gold bar	grate	silver cylinder
gold globe	iron spoon	silver tankard
gold grain	lightning rod	tin basin
gold tankard	log chain	

In addition to the metal articles just listed are several which are included as household equipment and supplies. However, the latter list also includes many items not made of metal. The items of household equipment and supplies are numerous, though none of them has high total frequencies or appears in all books. A few of the articles, such as dipper, feather duster, and tin candlestick, have ceased to be in common usage, but the majority of the household items mentioned are still in common use. Some of the more unusual terms follow:

baking plate	fire shovel	lamp wick
bedstead	flat iron	lantern
Brussels carpet	flour barrel	looking glass
cabinet organ	foot stool	loom
cake basket	jug	matting
crockery	lamp chimney	parlor organ
feather duster	lamp mat	parlor stove

pie knife	sauce plate	tin candlestick
pin cushion	stove pipe	wash board
poker	tea knife	wash stand
rolling pin	tea plate	what-not

In the books of this period 208 references are made to alcoholic beverages. Though this number is not large, the fact that all of the books included such references is evidence that the majority of the public did not at that time oppose the inclusion of such content in texts. The reference to temperance wine may be indicative of the temperance movement then under way. The following is a complete list of the alcoholic beverages found as problem subjects in the texts analyzed for the period:

alcohol	liquor	strong drink	California
ale	porter	whiskey	champagne
beer	rum	wine:	port
brandy	spirits	Burgundy	temperance

Means and methods of travel and transportation have changed considerably in the last 75 years. Consequently many of the problem subjects dealing with such items in arithmetics from 1851 to 1880 are no longer within the range of direct pupil experiences today. They were, however, common experiences of the pupils as a whole during this early period. Such items as buggy, carriage, chaise, gig, horse car, milestone, stage coach, and turnpike road were common during the Civil War period, but are seldom used by pupils today. Several other items, such as canal boats and even walking, are more characteristic of the latter half of the nineteenth century than they are of present times. The wide range of travel and transportation topics is indicative of an attempt on the part of the authors of these early books to draw the subjects of written problems of application from life situations as they existed at the time. The following is a list of the more unusual travel and transportation references made in the problems of the texts analyzed:

book carriage	gig	port boat
buggy	horse and wagon	schooner
carriage	horse car	sloop
cartage and carting	linch pins	stage coach
chaise	overland immigrant train	steam tug
drayage	packet boat	turnpike road
expressage		

Factories and companies of various kinds which indicate the types of industry mentioned in the problems of these texts also seem to have been drawn from industries then prevalent. Not many industries are used as problem subjects, however, and only a few are uncommon today. The kinds of factories and companies mentioned include:

ax factory	croquet factory	peat company
barrell manufactory	maple sugar manufactory	stage company

Very few types of machinery are mentioned in the problems, and the only references of this kind which might be considered unusual today are evener on a wagon, carding machine, and rigger.

Several references are made to fuels, a complete list of which follows:

charcoal
coal:
  anthracite
  bituminous
coal oil
fuel
gas
kerosene
oil
peat
petroleum

The period covered by this study, 1851 to 1880, includes the era of the Civil War. For this reason, it is logical that arithmetics written at the time should contain many military references. All except one of the books contain such references, the entire list of which follows:

army
army blanket
army brigade
army recruit
army wagon
army wagon train
artillery
artillery men
battalion
battering ram
battery
battle
besieged place
bullet
camp attendant
cannon
cannon ball
cartridge
cavalry
company of men
company of soldiers
corporal
drafted men
enemy
fort
fortification
fortress
garrison
gun boat
gun powder
gun
infantry
miners (army)
recruiting station
regiment
riflemen
sapper
soldier
troop

Several historical items are also included as the subjects of written problems in these textbooks. Apparently these references are to events and personages which pupils studied in school. The historical references found in the written problems are as follows:

Alfred the Great's death
American Civil War
American Revolutionary War
Andrew Jackson
battle of:
  Austerlitz
  Fort Donelson
  Hastings
  Moscow
  Lexington
  New Orleans
  Waterloo
Benjamin Franklin
birth of Israel
Chicago Fire
Christian Era
Christopher Columbus
creation of the world
Crusades
Daniel Webster
Declaration of Independence
destruction of Midian
founding of Carthage
founding of Rome
Franco-Prussian War
George Washington
inauguration of Washington
invention of:
  mariner's compass
  printing
  steamboat
  telescope
Isaac Newton
Julius Caesar
Mary Queen of Scots
Magna Charta signing
Methuselah
Napoleon
Pilgrims
pioneers
settlement of Jamestown
Socrates
Spanish Armada's defeat
surrender of Cornwallis
War of 1812
William, Prince of Orange

Some of the medicines found as the subjects of written problems are also interesting. The following list serves as another indication of the wide scope of the items which the authors drew from life interests and experiences for use as problem subjects:

aloe	castor oil	nitre	rhubarb
alum	cod liver oil	opium	(medicine)
arnica	drugs	pills	salt petre
Bay Rum	herbs	powders	sweet oil
calomel	laudanum	prescriptions	turpentine
cantharides	medicine	quinine	

Recreations which were common experiences of children three quarters of a century ago were also drawn upon to serve as the subjects of several problems in the various books analyzed. The following references to recreations were found in the texts:

croquet balls	kite and string	playmates	skipping rope
dolls	marbles	races	tops
dominoes	picnic party	rolling hoops	toys
drums	play ball	skates and	
horse-back riding	playground	skating	

Only a very few references in the problems dealt with literature, but the following items were found:

book of poems	Cooper's works
Burns' poems	Dickens' works
Byron's poems	Virgil

The public schools were growing and occupying an increasing center of interest from 1850 on, and it is only natural that the greater professional interest in education should have led the authors of books during the period to make numerous references to educational items. Most of these are items common to present-day schools, but a few, such as those in the list below, are less frequently heard today.

copy books	note paper	slate pencils
historical charts	quills	steel pens
ink stands	slate	tuition
literary institution		

The above detailed lists show clearly that the authors of the arithmetic texts studied made a definite effort to draw the subjects of their problems from the life interests and experiences of the people. Economic interests and business transactions, sociological conditions, and some miscellaneous items of dominant interest at the time, such as education and military topics, are referred to frequently. Obsolete problem subjects are largely eliminated from the content of the texts, as are also topics and problem situations not dealing with matters practical for the average elementary school pupil whose education may not extend into the higher phases of education. There are, however, a few problem topics involving obsolete, impractical, or improbable situations, such as the following:

purchasing superfine beaver hats
salter packing pork in barrels
person walking 1,323 miles
importer buying bales of linen
farmer paying laborers in corn
family consuming ¾ barrels of flour a week
allowance of bread daily to emigrants
farmer selling oxen
blacksmith using so much iron daily
man cradling wheat

circular field containing 10 acres
cost of gold snuff-box
men reaping acres of corn
oxen and horses eat grass of a close in so many days
stationer sells quills at a guinea a thousand
cost of slate and sponge
drover buying oxen
farmer sells tubs of butter
minutes required to breathe a room full of air
covering ball with oil cloth
time it takes carding machine to throw off wool
measurements of a wooden pail
winding machine raises so much coal in a certain time
transit of Venus
hoeing a field
one seat for two pupils in each schoolroom
amount of tallow used in candles
amount of foolscap in writing book
amount of lace for 16 head-dresses made by milliner
cost of lamp chimneys
turner turning bed posts
livery-man buys buffalo robes
number of horses before stage-coach and emigrant train
cooper making 7 barrels daily
riding to Harlem on a horse-car at 7¢ per way
amount of silt deposited by Mississippi River
boy apprenticed to a trade and amount he received
number of clapboards needed to cover side of house
sale of parlor organs and melodeons
amount of quills which can be obtained from geese
time required to read Bible
number of times heart beats in a day

The above list is sufficiently long and varied to show that, though a few of these problem subjects are not practical, most of them are not suited to arithmetics today because of changes in our national development. Between 1850 and 1880 our country was in the midst of rapid change toward big business and industry and toward greater interest in practical public education. The scope of the topics brings forth the old, the transitional, and also the newer aspects of our society. A few of the more common problem topics are traditional "type" problems, and include subjects like the following:

relation of ages of members of family at different times
bequeathing of an estate or property
rate of travel by foot, rail, etc.
wages or salaries paid for labor
family consumption of food
distribution of bankrupt property to creditors
time required to do different amounts of work by different numbers of men
supplies or provisions for large numbers of people
insurance
duties and imports
profit and loss of merchants or manufacturers
population differences or totals
total values of several farm products or animals sold
incomes and expenses
revolutions of wheel in traveling certain distance
selling goods on a commission

time required to fill or empty cistern through pipes of different sizes
cost of school books and supplies
depositing or withdrawing of money from bank
cost or quantity needed in papering, roofing, and carpeting
tax on property and tax rates
amounts of goods needed for clothing
number of books in libraries
transportation of products by boat
historical facts and dates
cost of construction work
areas of country or acreage
amount of fencing needed on farm
partnership
number of people engaged in certain occupations
distribution of articles among people
distances between towns
differences in time at different places

The various detailed lists just mentioned give a comprehensive picture of the wide range and practical associations of the problem subjects of written problems in the texts from 1851 to 1880. There is every indication that the authors attempted to draw their problem subjects from life situations and interests of the day. Since America was then in a transition from crafts to big industry, from rural to urban society, from slow to more rapid forms of transportation and communication, etc., these changes are reflected in the content of the arithmetics. The growth of the free public elementary school and the growing consciousness that elementary school arithmetic must serve the needs of the masses rather than those of a select few show their influences on arithmetic content. Even the shift of industry and agriculture and the migration of the whole population westward, with accompanying changes in social life activities and customs, are reflected in the problems.

Further relations of the problems to the divergent aspects of life at that day may be shown by a classified list of terms, phrases, and clauses, or even the entire statements of problems as they pertain to economic, sociological, and socio-economic situations and conditions. The following is a classified list of typical economic references:

Economics of the home—

Man spent money in repairs upon his house
Names and dimensions of the rooms in a house
Amount of carpet required to cover floor
Daily or weekly grocery bill
Amount of yearly rent on tenements
Cost of kerosene
Price of carpet, oilcloth, window shades, and other home fixtures
Purchase of lamp chimneys, match safes, flat-irons, etc.
Amount of tallow required to make so many candles
Cost of plastering a room
Value of house and furniture

Insurance—

Amounts and premiums of life insurance policies
Insurance on schoolhouse, home, or ship and cargo

Population—

Of towns, chief cities, states, and countries
White and colored populations in the United States

Transportation—

Cargo of barrels of flour transported by freight train
Ship carrying cargo obliged to cast so much overboard during a storm
Distance: length of rivers, railroads, and other transportation routes; distance between cities
Costs of transportation

Business transactions—

Man bought span of horses and yoke of oxen
Speculator bought and sold wheat
Investing income in mortgages
Loss of money on goods sold
Amount of taxes paid
Depositing of money in bank
Bequeathing of money or property
Purchase of railroad and other stocks and bonds
Sale of cloth, groceries, implements, etc.
Wages of labor
Purchase or sale of shares in industry or business
Payment to an attorney for collecting a claim
Broker makes sales for a commission
Allowance on goods for breakage
Payment of interest on a note
Payment of dividends on stock
Salaries paid to government officials
Cost of a money draft
Merchant and farmer barter
Manufacturer sells shoes, and other products
Duties on imports
Buying and selling chaise and harness
Purchase of school supplies
Raising money by taxes for schools
Stationer sells quills at a profit

Travel—

Cost of travel by horse, car, stage, railroad, steamboat, etc.
Cost of canal boat and horses
Time required to travel certain distances by the various methods

Craft, industry, and occupation—

In a reaper factory 2,346 reapers are constructed annually
Man saws 1¼ cords of wood in a day
If a man can hoe a field in 7¼ days, . . .
Custom millers take ⅛ of the quantity of grain as pay for grinding it
If 6 men mow 12 acres of grass in 2 days of 10 hours each, . . .
An architect charges 1½% for plans and specifications, and 2½% for superintending a building
If 50 looms weave a quantity of cloth in 36 days, . . .
The dairy of a farmer produces $600
If a man with reaper can cut 8 acres of wheat in a day, . . .
Drover drives cattle from Texas to Chicago
Carding machine throws off 54 lbs. of wool in nearly three hours
Building a house, railroad, factory, fence, etc.
Digging a ditch
Mechanic earns $62.87½ in a month
A salter packed pork in barrels
A cabinet-maker sold furniture

A cooper makes 7 barrels in a day
A livery-stable keeper
A boy 14 years old was apprenticed to a trade
A turner turns bed posts
Fisherman catches fish

The following is a list of typical sociological references found in the problems of the texts studied:

Dress—

A lady having $25, paid $2½ for a pair of gloves, $15¾ for a bonnet, and $3¾ for some lace
Bought 5 assorted cases of men's boots
Milliner made head-dresses
A man paid 18 dollars for a coat, 33 dollars for an oversack, and 9 dollars for pantaloons
When 72 ladies require 567 yds. for their dresses, how many yards necessary for one lady?
Superfine beaver hats, at 4 dollars a piece
Six caps cost 9 dollars
Lady purchased shawl

Food—

If 5 children at picnic eat a certain amount of cake, . . .
It requires 656 pounds of meat to supply 34 soldiers 3½ weeks
If a family of 8 persons can use 3½ gallons of milk in one week,...
If a family uses 1⅜ barrels of flour in 1 month, . . .
A company of emigrants has a supply of bread for 25 days

Health—

My bedroom is 15 feet long, 12 feet wide, and 9 feet high; in how many minutes shall I breathe the room full of air, if I breathe 1 cubic foot in two minutes?
How many times heart beats in a minute
Man lost 20% of his weight through sickness

Human relations—

A person owes money to several people
Five men contributed a certain sum to charity
Men work together to accomplish piece of work
Men give money to beggars
Candidate for office receives votes
Three men hire a pasture in common
Constituency of an army

Living conditions—

How many quills can be obtained from so many geese
Use of candles and kerosene lamps
Expenses for a young man attending college or for boy at school
Living expenses for a teacher
A woman paid 36 cents for iron spoons, at 6 cents apiece

Morals—

An officer is in pursuit of a thief who has some miles the start
A young man lost 31¼ per cent of his money in gambling
A thief was brought before a judge
Cost of temperance wine
Reading verses of the Bible
Man spends so much for cigars and drink each day

National progress—

Emigration westward
Construction of railroads

Building of factories
Population of states according to census
Time between historical events
Building and support of schools by taxation

Recreation—

Gentleman spent ⅓ of his income traveling, ⅛ of the remainder in purchase of book, and the remainder on painting and other works of art
Willie had given him two books to read
A little girl bought a jumping rope, a doll, a story-book, a tea-set, and a box of dominoes
A sportsman spends certain portions of his time in smoking, gunning, loafing, eating, drinking, and sleeping
A lady spends certain portions of her time in making calls, reading novels, and receiving calls
Boy buys firecrackers and torpedoes for Fourth of July

Education and schools—

In a schoolroom are 2 seats for classes, and on each seat are 6 pupils
Studies in the school curriculum
Dimensions of schoolroom necessary to provide certain number of pupils with sufficient air
Attendance at school
Cost of books and supplies
Per cent grade made by pupil on an examination
School support
Number of sheets of foolscap in a writing book

The foregoing typical problem topics show the comprehensiveness of the adaptation of problem subjects to the many aspects of social and economic life common between 1851 and 1880. Likewise, the many problems dealing with matters of historical interest reveal interests characteristic of the people of the period. Nearly all problems are practical except for the size of the whole numbers and fractions used in some of the books. Many numbers used in the problems are much larger than the pupil would normally meet in life situations. Similarly some denominations of the fractions are used in situations in which they would almost never occur. Examples of these follow:

12 5/9, 11/12, and 5/9 cents
39 3/19, 5/13, 10/87, and 249 4/21 dollars
3/7 pounds of sugar
36 1/5, and 3360 4/11 feet
30 4/7 minutes
16/5, and 48 3/13 gallons
9 1/3 pounds of lard
463 2/7 bushels of wheat
96/5 lbs. of beef
Reducing 25200/11 seconds to the fraction of a day
Reducing 4/25 inches to the fraction of a yard

Unusual problems.—A few other impractical problems were found, though they were not numerous. Examples of some of these are:

In October, 1871, the great fire in Chicago burned over an area of 2,124 acres. The estimated loss occasioned by the fire was $196,000,000. What was the average loss per acre?

A man expended $3,750 in repairs upon his house. This sum was 25% more than ½ the cost of the house. How much did it cost?

A man took 2,126 steps going from home to his place of business, 3,197 while in his store, 6,239 going from there to the park, 5,782 while in the park, 8,573 going from there home. What was the number of steps taken by him from the time he left until he re-entered his house?

How many signs of the Zodiac in 678,542 seconds of arc of celestial longitude?

What decimal of a leap year are 185 days, 10 hours, 10 minutes, 10 seconds?

How many times will a coach-wheel turn in going from Cambridge to London, a distance of 52 miles, the circumference of the wheel being 16 ft. 6 in.?

A circular field contains 10 acres; what is the length of its diameter?

If a wagon costs $80, what would be the cost of a harness if 7/16 of the cost of the wagon were 7/9 of the cost of the harness?

The purely puzzle type of problem was not found in these texts. Since the authors had made every effort to eliminate the obsolete, and since these books were written less than 100 years ago, the expressions or terms used are not particularly unusual today. There are, however, a few terms, such as tubs of butter, hoeing corn, slates and slate pencils, and wild land, which are not common today but which were used frequently during the period in which the books were written.

From this analysis of the written problems of the texts of this period, it is evident that the authors approached rather definitely their goal of providing texts of practical use to pupils in solving problems met in life situations as they existed at that time.

SUMMARY AND GENERAL CONCLUSIONS

Some of the interesting facts found in this analysis of the texts and the teaching of arithmetic from 1851 to 1880 are as follows:

1. All texts surveyed for this period are well bound and are written on a good quality of paper. On the whole the print is somewhat smaller than that used in arithmetics today, but is larger than that found in earlier texts. The quality of the printing is good and the materials are not difficult to read.

2. Three series of two books each are included in the group of books analyzed for this period.

3. The authors have aimed toward presenting their materials simply, clearly, and concisely.

4. An attempt has been made to grade materials in the texts from the simplest to the most difficult.

5. In most of the books the natural rather than the purely logical order of sequence of materials is followed. The stages of the child's mental development have been kept in mind in organizing the content. However, a few of the books still adhere to the logical order of arranging materials.

6. Both the inductive and the deductive methods are used, but

most books use a combination of the two rather than adhere to one or the other strictly. The combined method is generally used in those books which definitely aim at combining oral and written arithmetic. In such books the mental exercises usually precede the statement of a rule or principle, while the examples and written exercises follow it.

7. Several of the books provide for systematic reviews at various intervals.

8. A number of the authors urge that rules are not to be memorized and followed blindly and slavishly. Understanding is given precedence over the mechanical solving of problems.

9. Some of the authors emphasize the point of view that discipline of the mind, or the development of reasoning power, is the most important goal in the study of arithmetic, and that such development can best be brought about by requiring each pupil to explain analytically, step by step, each problem solution.

10. Nearly all authors of the period make positive attempts to adapt and apply arithmetic to practical life situations—to give practice in solving the types of problems which may be met in everyday experiences.

11. Most of the books provide many problems of like nature in order to develop speed and accuracy in handling problems.

12. On the whole, the authors have attempted to avoid treatment of processes not needed in daily business activity and to eliminate obsolete terms and processes.

13. The longest book is 344.91 standard pages and the shortest is 71.50 standard pages. Eleven of the books contain more than 250 pages each.

14. All 16 books treat arithmetic symbols, arithmetic (general aspects), total numeration, total fundamental processes in whole numbers, total vulgar (common) fractions, total decimals, and measures (tables and their uses), total compound denominate numbers, total geometric forms, total percentage, partial payments, ratio, and total powers and roots.

15. In all books of the unit combined, more total space is given to fundamental processes as applied to whole numbers than to any other topic. It is followed in descending order by total percentage, total vulgar (common) fractions, total compound denominate numbers, total decimals, total geometric forms, total powers and roots, and measures (tables and their uses). Each of the other topics is given less than 4 per cent of space in the 16 books combined.

16. Barter, bonds, building association business, construction workers', farmers', and painters' estimates, and mechanics are treated by only one or two authors each.

17. Bonds, building association business, and construction workers', farmers', and painters' estimates do not appear as topics in the arithmetics of this period until about 1877. On the other hand, barter drops out in 1862 and mechanics in 1872.

18. More space is given in these texts to division than to any of the other fundamental processes, and subtraction is given the least space.

19. More space is given to written problems than to any other aspect of content in all 16 texts combined. Examples and their explanations and drill problems follow in amount of space used.

20. Thirteen of the 16 books include all 16 types of content and all of the others include at least 14 types.

21. Some authors include answers to their written and drill problems and others do not, but there is not much agreement of opinion on this point.

22. Nearly twice the percentage of space is given to multiplication and division of common fractions and of decimals as to addition and subtraction.

23. In only four instances is any type of content given more than 30 per cent of the space in any of the texts.

24. There seems to be almost no evidence of trends in the inclusion or exclusion of certain types of content in the arithmetics of the period.

25. Approximately three fourths of the subjects of all written problems in the books may be classified as economic.

26. The four most important economic problem subjects, in descending order of their frequency of mention in written problems in the texts studied, are food and farm products (3,918), occupations (2,196), cloth and clothing (1,613), and buildings and construction work (1,077). All other economic problem subjects are mentioned less than 525 times each in all books combined.

27. Of the socio-economic problem subjects education and travel are included most often; of the sociological subjects, alcoholic beverages; and of the miscellaneous subjects, animals. Education is referred to 460 times; travel, 261 times; alcoholic beverages, 208 times; and animals, 1,115 times. No other socio-economic, sociological, or miscellaneous subject is mentioned more than 200 times in the books.

28. Economic, socio-economic, or sociological problem subjects are mentioned in all books on the average more than 16 times per page of written problems. It seems, therefore, that the written problems center the pupil's attention on practical subjects, or life situations.

29. The range of specific problem subjects under major headings is on the whole especially broad. For example, in the list of occupations a total of more than 235 different lines of work are mentioned. This is one of the largest of the problem subject divisions, but it shows typically the wide range of specific practical subjects used in concrete problems.

30. Very few problems found in these texts may be considered as impractical in fact or purpose. A few impracticalities, however, are found with respect to the size of the whole numbers or the odd denominations of fractions used in connection with certain problem subjects.

31. Such items as tubs of butter, slates and slate pencils, and wild land are representative of expressions and terms characteristic of the period in which the texts were written.

32. On the whole, the texts meet the needs of those who continue their education at higher levels as well as of those who do not.

A List of Bulletins in the Field of Education, Indiana University

By KATHLEEN DUGDALE

The School of Education at Indiana University has published the following bulletins. All of these may be obtained from the University Bookstore for 50 cents postpaid unless otherwise noted.

Proceedings of the High School Principals' Conference (November 23 and 24, 1923). Vol. I, No. 1, 1924. 85 p. (Supply exhausted.)

Investigation of Nursing as a Professional Opportunity for Girls, Part I, Technical Study; Part II, Vocational Information Bulletin. By Florence E. Blazier. Vol. I, No. 2, 1924. 69 p.

Proceedings of the Eleventh Conference on Educational Measurements. Vol. I, No. 3, 1925. 141 p.

Proceedings of the High School Principals' Conference (November 14 and 15, 1924). Vol. I, No. 4, 1925. 49 p. (Supply exhausted.)

First Revision of the Bibliography of Educational Measurements. Compiled by the Bureau of Cooperative Research. Vol. I, No. 5, 1925. 147 p. (Supply exhausted.)

Proceedings of the Twelfth Conference on Educational Measurements. Vol. I, No. 6, 1925. 76 p.

The Effect of Population upon Ability to Support Education. By Harold F. Clark. Vol. II, No. 1, 1925. 28 p.

Proceedings of the High School Principals' Conference (November 20 and 21, 1925). Vol. II, No. 2, 1925. 77 p. (Supply exhausted.)

A Cross-Indexed Bibliography on School Budgets. By Harold F. Clark. Vol. II, No. 3, 1926. 66 p.

A Comparison of the Results Made on Certain Standardized Tests by Pupils in the Bloomington High School Who Were Taught in Classes of the Same Grade by University Student Teachers and by Regular High School Teachers. By Carl G. F. Franzén. Vol. II, No. 4, 1926. 19 p.

Proceedings of the Thirteenth Annual Conference on Educational Measurements. Vol. II, No. 5, 1926. 103 p.

When to Issue School Bonds. By Harold Florian Clark and Paul Royalty. Vol. II, No. 6, 1926. 16 p.

Students' Attitude Toward Examinations. By Grover T. Somers. Vol. III, No. 1, 1926. 48 p.

Proceedings of the High School Principals' Conference (November 12 and 13, 1926). Vol. III, No. 2, 1926. 27 p.

Index Numbers in School Administration. By Harold F. Clark. Vol. III, No. 3, 1927. 35 p.

Topical Analysis of 234 School Surveys. Compiled by the Bureau of Cooperative Research. Vol. III, No. 4, 1927. 111 p. (Supply exhausted.)

Proceedings of the Fourth Annual Conference on Elementary Supervision. Vol. III, No. 5, 1927. 64 p.

Proceedings of the Fourteenth Annual Conference on Educational Measurements. Vol. III, No. 6, 1927. 66 p.

Some Phases of the Junior College Movement. By I. Owen Foster, Harold F. Clark, Willard W. Patty, and Leo M. Chamberlain. Vol. IV, No. 1, 1927. 125 p. (Supply exhausted.)

Second Revision of the Bibliography of Educational Measurements. By Henry Lester Smith and Wendell William Wright. Vol. IV, No. 2, 1927. 251 p. (75¢)

Bibliography of School Buildings, Grounds, and Equipment, Part I. By Henry Lester Smith and Leo Martin Chamberlain. Vol. IV, No. 3, 1928. 326 p. (75¢)

Proceedings of the High School Principals' Conference (November 18 and 19, 1927). Vol. IV, No. 4, 1928. 54 p.

The Economic Effects of Education. By Harold F. Clark. Vol. IV, No. 5, 1928. 39 p.

Proceedings of the Fifteenth Annual Conference on Educational Measurements. Vol. IV, No. 6, 1928. 73 p.

Proceedings of the Fifth Annual Conference on Elementary Supervision. Vol. V, No. 1. 1928. 54 p.

Proceedings of the High School Principals' Conference (November 16 and 17, 1928). Vol. V, No. 2, 1928. 33 p.

The Development and Use of a Composite Achievement Test. By Wendell William Wright. Vol. V, No. 3, 1929. 90 p.

An Analysis of the Attitudes of American Educators and Others Toward a Program of Education for World Friendship and Understanding. By Henry Lester Smith and Leo Martin Chamberlain. Vol. V, No. 4, 1929. 109 p.

Tentative Program for Teaching World Friendship and Understanding in Teacher Training Institutions and in Public Schools for Children Who Range from Six to Fourteen Years of Age. By Henry Lester Smith and Sherman Gideon Crayton. Vol. V, No. 5, 1929. 54 p.

Proceedings of the Sixteenth Annual Conference on Educational Measurements. Vol. V, No. 6, 1929. 96 p.

Proceedings of the Sixth Annual Conference on Elementary Supervision. Vol. VI, No. 1, 1929. 73 p.

An Analysis of the Duties of County School Superintendents and Superintendents of Schools in Certain Cities in Indiana. By Henry Lester Smith and Leo Martin Chamberlain. Vol. VI, No. 2, 1929. 94 p.

Proceedings of the High School Principals' Conference (November 22 and 23, 1929). Vol. VI, No. 3, 1930. 51 p.

Cooperative Studies in Secondary Education. By Henry Lester Smith and Carl G. F. Franzén. Vol. VI, No. 4, 1930. 121 p.

Proceedings of the Seventeenth Annual Conference on Educational Measurements. Vol. VI, No. 5, 1930. 103 p.

Proceedings of the Seventh Annual Conference on Elementary Supervision. Vol. VI, No. 6, 1930. 102 p.

A Study in Teacher Supply and Demand in Indiana. By I. Owen Foster, Robert K. Devricks, Harry N. Fitch, Earl C. Bowman, and George L. Roberts. Vol. VII, No. 1, 1930. 77 p.

Proceedings of the High School Principals' Conference (November 7 and 8, 1930). Vol. VII, No. 2, 1930. 70 p.

The Philosophy of Human Relations: Individual and Collective—A Source Book. By Henry Lester Smith and Harold Littell. Vol. VII, No. 3, 1931. 326 p. (75¢)

The Psychology of Human Relationships: Individual and Social—A Source Book. By Henry Lester Smith and Levi McKinley Krueger. Vol. VII, No. 4, 1931. 107 p.

Proceedings of the Eighteenth Annual Conference on Educational Measurements. Vol. VII, No. 5, 1931. 83 p.

Efficiency in College Management. By John Dale Russell. Vol. VII, No. 6, 1931. 143 p.

Bibliography of School Surveys and of References on School Surveys. By Henry Lester Smith and Edgar Alvin O'Dell. Vol. VIII, Nos. 1 and 2, 1931. 212 p. (75¢)

Proceedings of the Nineteenth Annual Conference on Educational Measurements. Vol. IX, No. 1, 1932. 139 p.

Bibliography of School Buildings, Grounds, and Equipment—Part II. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 2, 1933. 182 p.

Bibliography of School Buildings, Grounds, and Equipment—Part III. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 3, 1933. 130 p.

A Brief Summary of Literature on Leadership. By Henry Lester Smith and Levi McKinley Krueger. Vol. IX, No. 4, 1933. 80 p.

Proceedings of the Twentieth Annual Conference on Educational Measurements. Vol. X, No. 1, 1933. 98 p.

Bibliography of College and University Buildings, Grounds, and Equipment. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. X, No. 2, 1934. 199 p. (75¢)

Factors Affecting the Organization of School Attendance Units. By Raleigh Warren Holmstedt. Vol. X, No. 3, 1934. 32 p.

The Old World Historical Background of Religious and Moral Education in Schools. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. X, No. 4, 1934. 144 p.

Proceedings of the Twenty-first Annual Conference on Educational Measurements. Vol. XI, No. 1, 1934. 96 p.

Bibliography of School Buildings, Grounds, and Equipment—Part IV. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. XI, No. 2, 1935. 216 p.

A Brief Survey of Present-Day Religious and Moral Education in the Schools of Countries Other Than the United States of America. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. XI, No. 3, 1935. 185 p.

Some Practical Efforts to Teach Good Will. By Henry Lester Smith and Peyton Henry Canary. Vol. XI, No. 4, 1935. 169 p.

Proceedings of the Twenty-second Annual Conference on Educational Measurements. Vol. XII, No. 1, 1935. 97 p.

A Basis for the Improvement of Education in Rural Monroe County, Indiana. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. XII, No. 2, 1936. 168 p.

Reading Readiness—A Prognostic Study. By Wendell William Wright. Vol. XII, No. 3, 1936. 46 p.

Proceedings of the Twenty-third Annual Conference on Educational Measurements. Vol. XII, No. 4, 1936. 60 p.

Bibliography of Literature on the Teaching of English. By Henry Lester Smith and William Isaac Painter. Vol. XIII, No. 1, 1936. 299 p.

Bibliography of Literature on Education in Countries Other Than the United States of America. By Henry Lester Smith and William Isaac Painter. Vol. XIII, No. 2, 1937. 341 p. (75¢)

Character Development through Religious and Moral Education in the Public Schools of the United States. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. XIII, No. 3, 1937. 137 p.

Proceedings of the Twenty-fourth Annual Conference on Educational Measurements. Vol. XIII, No. 4, 1937. 100 p.

Bibliography of Literature on Education in Countries Other Than the United States of America (January 1, 1919, to December 31, 1934). By Henry Lester Smith and William Isaac Painter. Vol. XIV, No. 1, 1937. 139 p.

Two Studies in Education. By Henry Lester Smith and Merrill Thomas Eaton. Vol. XIV, No. 2, 1938. 42 p.

Bibliography of School Surveys and of References on School Surveys (Supplement to Vol. VIII, Nos. 1 and 2). By Henry Lester Smith and Edgar Alvin O'Dell. Vol. XIV, No. 3, 1938. 144 p. (75¢)

Proceedings of the Twenty-fifth Annual Conference on Educational Measurements. Vol. XIV, No. 4, 1938. 37 p.

Remedial Instruction in Reading with College Freshmen. By Nila Banton Smith. Vol. XV, No. 1, 1938. 35 p.

Two Studies in Arithmetic. By Henry Lester Smith and Merrill Thomas Eaton. Vol. XV, No. 2, 1939. 91 p.

The Relation of Retention to Speed of Learning. By Henry Lester Smith and Merrill T. Eaton. Vol. XV, No. 3, 1939. 105 p.

Proceedings of the Twenty-sixth Annual Conference on Educational Measurements. Vol. XV, No. 4, 1939. 53 p.

An Experimental Study of Standards for the Selection of Candidates for Teacher-Training Institutions. By Henry Lester Smith and Merrill Thomas Eaton. Vol. XVI, No. 1, 1939. 72 p.

State Control of Public School Finance. By Raleigh Warren Holmstedt. Vol. XVI, No. 2, 1940. 71 p.

Teacher Tenure in Indiana and the Courts. By Henry Lester Smith and R. Foster Scott. Vol. XVI, No. 3, 1940. 81 p.

Twenty-seventh Annual Conference on Educational Measurements. Vol. XVI, No. 4, 1940. 37 p.

A Study of the English Usage, Spelling, and Vocabulary of 251 Graduate Students at Indiana University. By Henry Lester Smith and Merrill T. Eaton. Vol. XVI No. 5, 1940. 71 p.

The Teaching of Arithmetic to Low-Ability Students in the Elementary Schools. By Henry Lester Smith and Merrill T. Eaton. Vol. XVI, No. 6, 1940. 130 p.

An Analysis of the Achievement of 164 Sophomores Enrolled in Teacher-Training Courses at Indiana University. By Henry Lester Smith and Merrill T. Eaton. Vol. XVII, No. 1, 1941. 31 p.

The Scholastic Achievement of Athletes at Indiana University. By Henry Lester Smith and Merrill T. Eaton. Vol. XVII, No. 2, 1941. 16 p.

Twenty-eighth Annual Conference on Educational Measurements. Vol. XVII, No. 3, 1941. 42 p.

Legal Relations of Pupils and Parents to the Public Schools of Indiana—Part I. By Henry Lester Smith and R. Foster Scott. Vol. XVII, No. 4, 1941. 81 p.

Legal Relations of Pupils and Parents to the Public Schools of Indiana—Part II. By Henry Lester Smith and R. Foster Scott. Vol. XVII, No. 5, 1941. 72 p.

A Study of Students Transferring from Indiana University. By Merrill T. Eaton. Vol. XVII, No. 6, 1941. 26 p.

An Analysis of Arithmetic Textbooks (First Period—1790-1850). By Henry Lester Smith and Merrill T. Eaton. Vol. XVIII, No. 1, 1942. 55 p.

Education in Guatemala. By Juan Espéndez-Navarro and Henry Lester Smith. Vol. XVIII, No 2, 1942. 96 p.

A Study of Indiana University Withdrawals. By Merrill Thomas Eaton. Vol. XVIII, No. 3, 1942. 20 p.

Education in Mexico. By Henry Lester Smith. Vol. XVIII, No. 4, 1942. 95 p.

Twenty-ninth Annual Conference on Educational Measurements, and *A Study of the Achievement of Freshman Students Holding County Scholarships.* By Merrill T. Eaton. Vol. XVIII, No. 5, 1942. 57 p.

An Analysis of Arithmetic Textbooks (Second Period—1821 to 1850, and Third Period—1851 to 1880). By Henry Lester Smith and Merrill Thomas Eaton. Vol. XVIII, No. 6, 1942. 112 p.